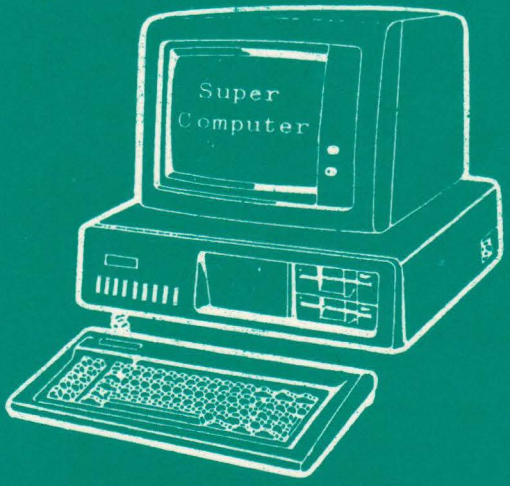
PC/XT

Personal Computer

USER'S GUIDE



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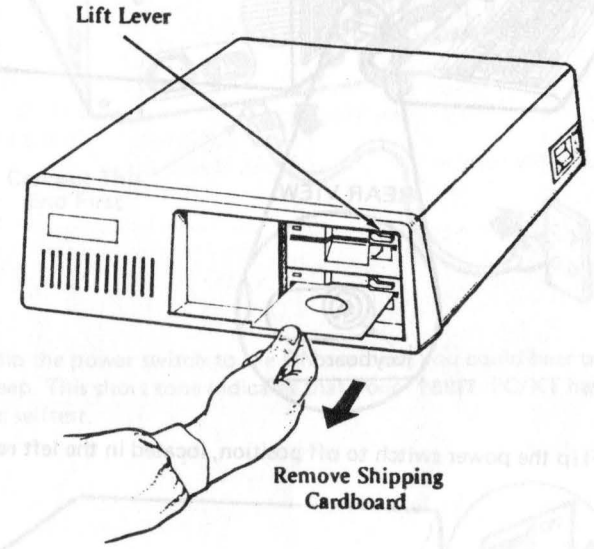
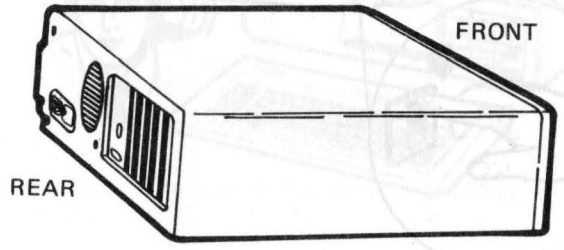
1 SET UP YOUR PC/XT

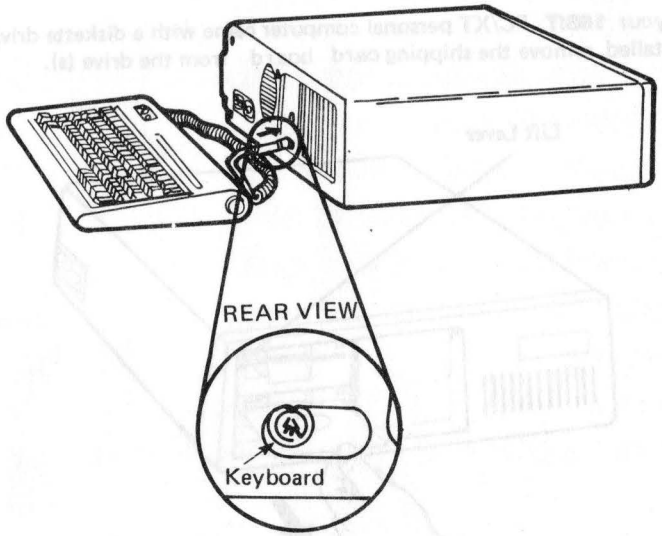
1. If your **16BIT** PC/XT personal computer came with a diskette drive installed, remove the shipping card board from the drive (s).



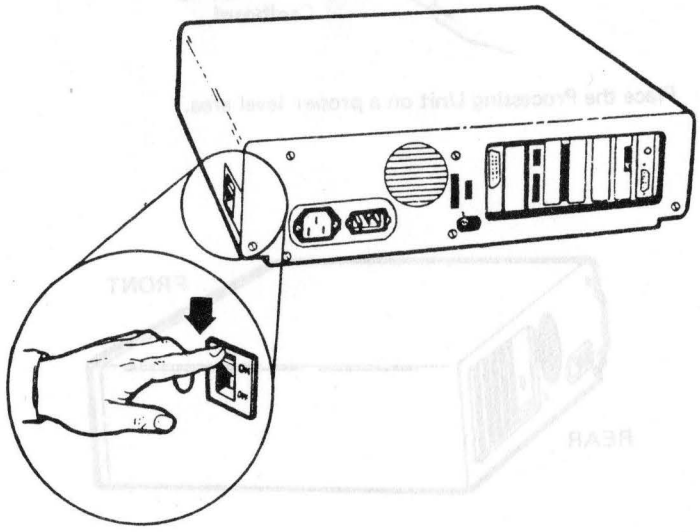
2. Place the Processing Unit on a proper level area.



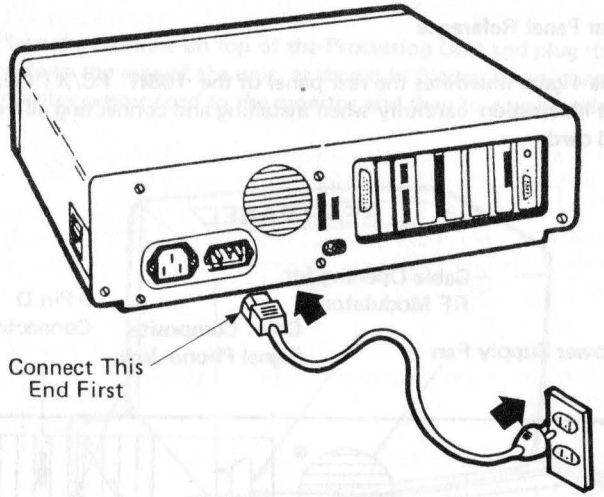
3. Place your keyboard in front of the Processing Unit and connect the coiled cable, to the rear of the cabinet, as shown in Figure. The unit will not initialize without the keyboard cable properly plugged.



4. Flip the power switch to off position, located in the left rear of the unit.



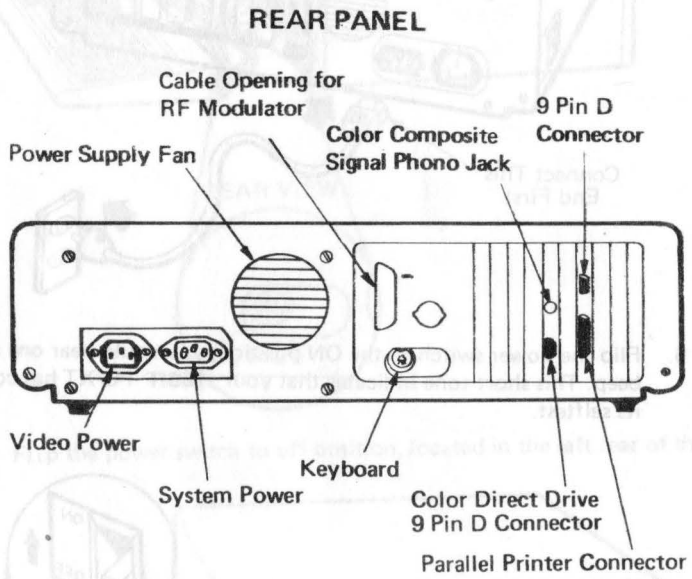
Plug first the power cord to the Processing Unit, then to a wall outlet.



6. Flip the power switch to the ON position, you could hear one short beep. This short tone indicates that your **16BIT** PC/XT has completed its selftest.

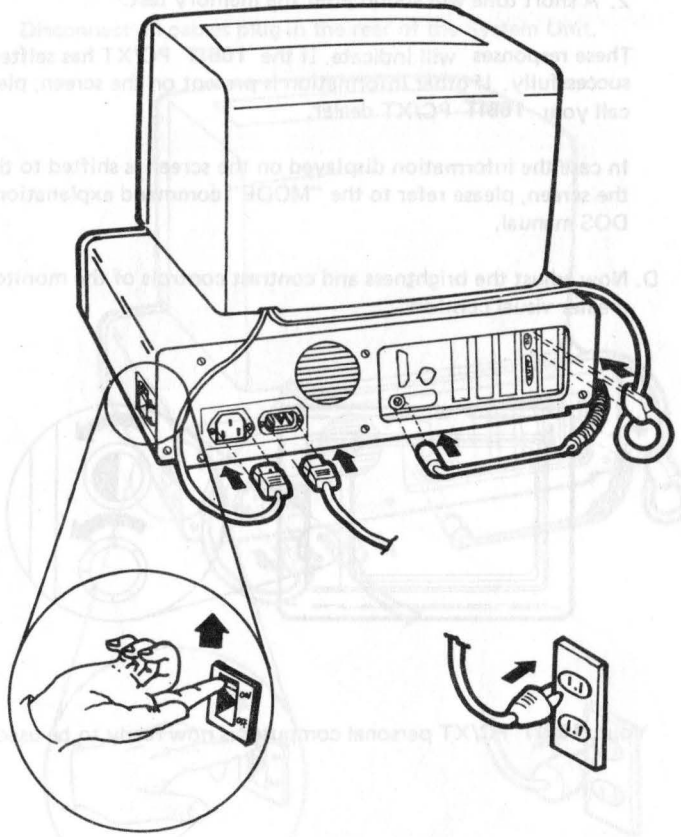
7. Rear Panel Reference

This figure illustrates the rear panel of the **168IT** PC/XT Please follow this illustration carefully when installing and connecting all your cables and cards.



8. System Test

A. Place the monitor on top of the Processing Unit and plug the monitor cable to the rear of the unit, as shown in Figure. Then connect the monitor power cord to the monitor and then to a wall outlet.



B. Turn the video controls of your monitor completely clockwise.

C. When the **16BIT** PC/XT is powered on, it performs a selftest that takes between 3 to 30 seconds, depending on how much memory the system has.

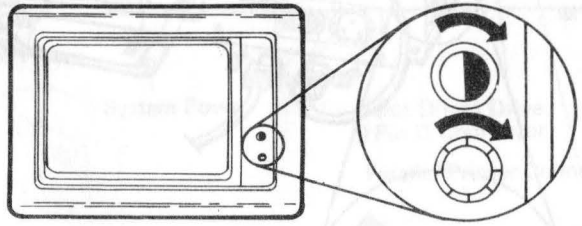
Flip the power switch to the ON position. These occurrences should be noted:

1. The cursor will appear on the monitor screen.
2. A short tone will sound after the memory test.

These responses will indicate, if the **16BIT** PC/XT has selftested successfully. If other information is present on the screen, please call your **16BIT** PC/XT dealer.

In case the information displayed on the screen is shifted to the left of the screen, please refer to the "MODE" command explanation in your DOS manual.

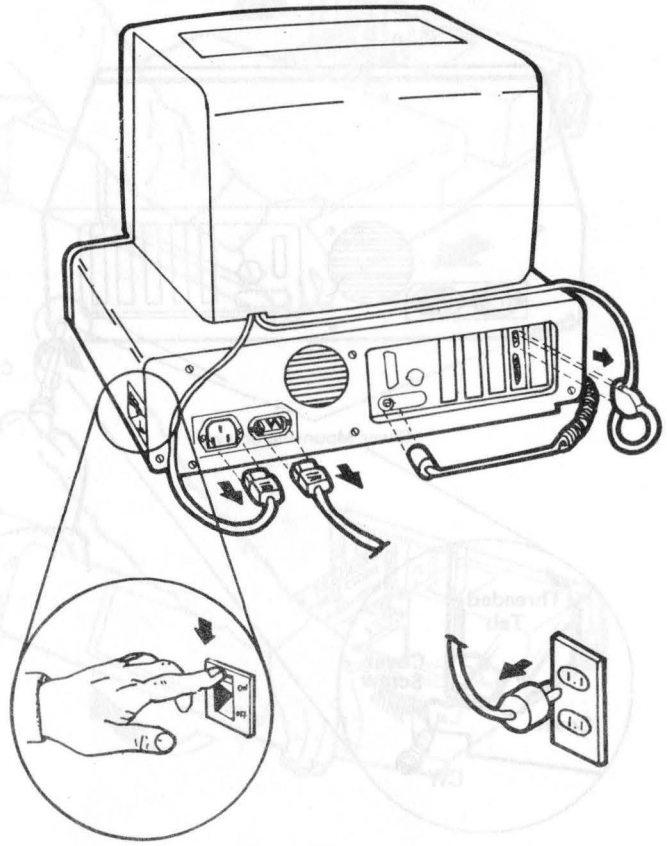
D. Now adjust the brightness and contrast controls of the monitor for greater visual comfort.



Your **16BIT** PC/XT personal computer is now ready to be used.

2 OPTIONS

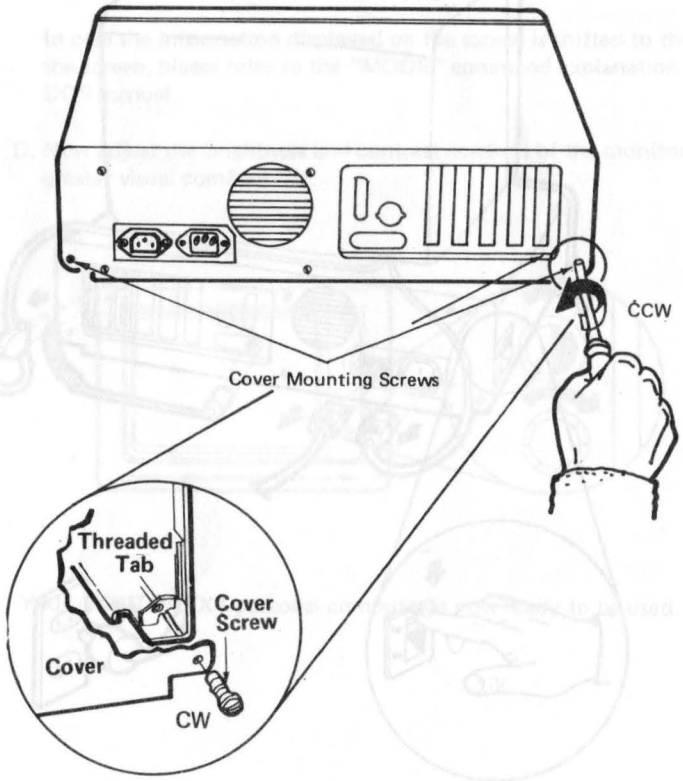
1. Position System Unit Switch to OFF.
2. Position any external option power switches to OFF (such as printer, TV, cassette, etc.).
3. Unplug System Unit and all other options from wall outlet.
4. Disconnect all cables plug in the rear of the System Unit.



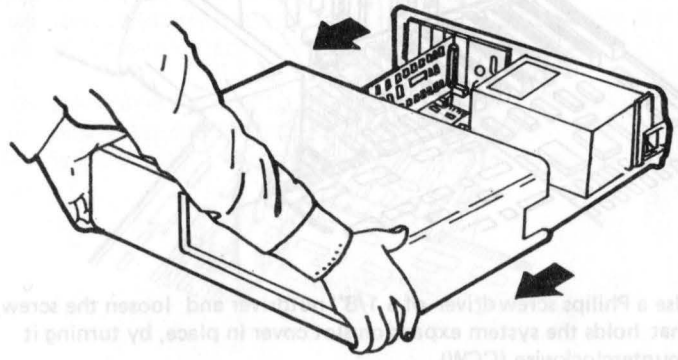
5. Set your keyboard and all external options in an area away from the system work surface.

6. Position the System Unit to allow access to the rear.

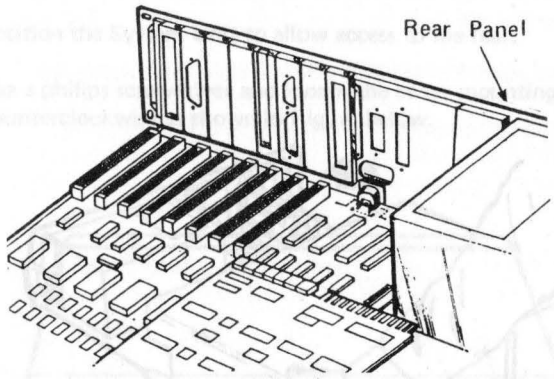
7. Use a philips screwdriver and loosen the cover mounting, screw it counterclockwise as shown in Figure below.



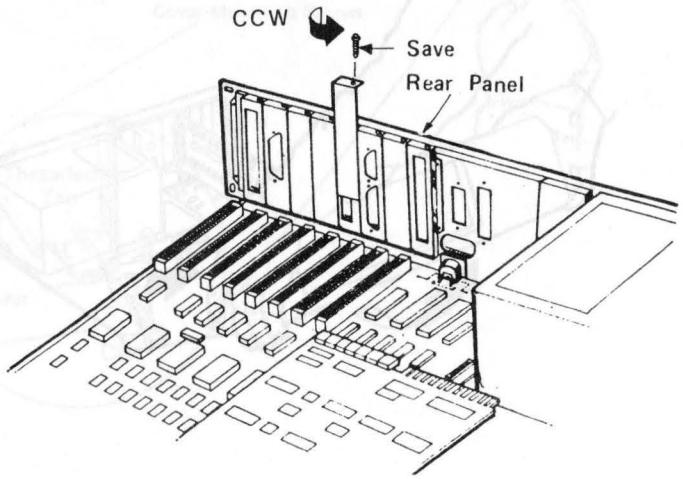
8. Carefully slide the System Unit cover away from the unit towards the front as indicated by Figure below. Till cover will go no further, tilt cover up and remove cover from the base and set aside.



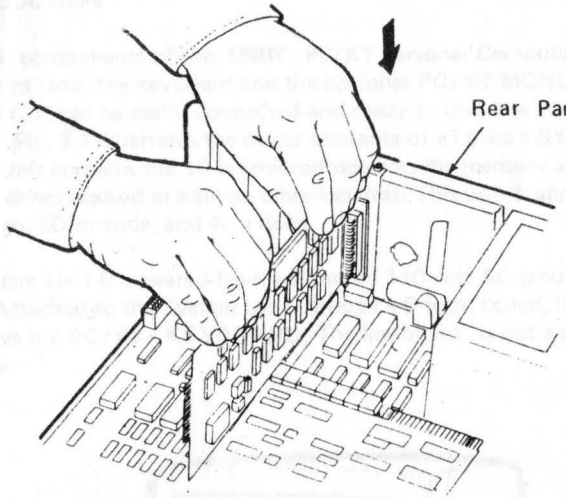
9. Look at the left rear panel. There are 5/7/8 system expansion slots, you may install your option in any one of the slots.



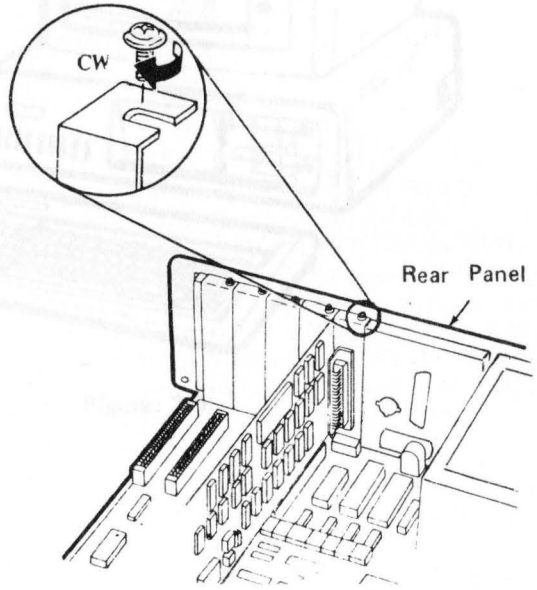
10. Use a Philips screw driver of a 1/8" nutdriver and loosen the screw, that holds the system expansion slot cover in place, by turning it counterclockwise (CCW).



11. Hold the option by the top corners and firmly press the option into any slot you like.



12. Use a Philips screwdriver of a 1/8" nutdriver and lock the screw, that hold the option. Then turn the screw clockwise (CW).



3 OVERVIEW OF THE PC/XT SYSTEM

INTRODUCTION

The basic components of the **16BIT** PC/XT Personal Computer consist of the System Unit, the keyboard and the optional PC/XT MONOCHROME DISPLAY. It can be easily connected and ready to use, in a matter of minutes. Fig. 3-1 illustrates the major elements of a 16-bit SYSTEM. The System Unit contains the 16-bit microprocessor, the memory and one or two diskette drives housed in a single table-top unit. This unit is approximately 14cm high, 50cm wide, and 4cm deep.

The System Unit is powered from a standard 110-volt AC grounded wall outlet. Attached to the System Unit through a 6-foot, coiled, like telephone cable, was the PC/XT KEYBOARD. The keyboard is not a rigidly attaching cable.

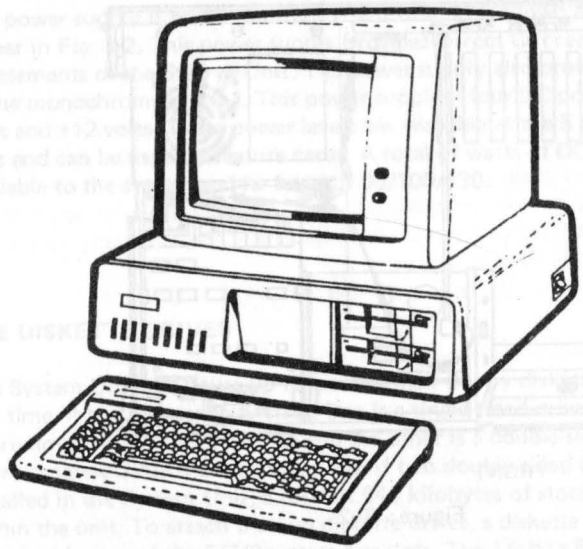


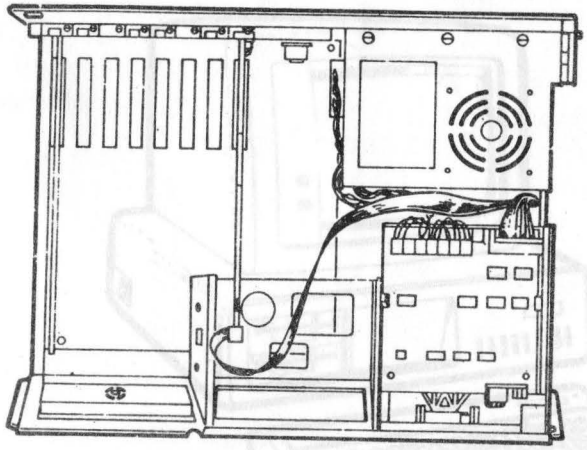
Figure: 3-1

This unit attaches to the System Unit, via two cables – a power cable and a signal cable, via signal cable, but it obtains its power from a standard 110-volt AC wall outlet.

THE SYSTEM UNIT

The System Unit contains the 16-bit microprocessor, the Read-Only Memory (ROM), the user or Random-Access Memory (RAM), the power supply, and a speaker for audio and music applications, plus five or seven for PC or eight for XT expansion slots, to allow easy expansion of the system. One or two diskette drives can also be mounted in the System Unit. Fig. 3-2 is the illustration inside the System Unit, after the cover has been removed.

REAR



FRONT

Figure: 3-2

THE MOTHER BOARD

The heart of the System Unit is the processor board, which fits horizontally in the base of the System Unit. The processor board contains much of the essential electronics of the system, including the 8088 microprocessor, up to 256KB (Kilobytes) of Random-Access Memory (RAM), 64KB of Read-Only Memory (ROM), I/O adapters for the keyboard, and audio speaker. The most important features of the mother board are the 5/7/8 system-bus slots that allow additional features and interface devices to be added to the System Unit. Much of this manual will be devoted to describing the functions that are available at the system bus in these 5/7/8 card slots.
In Fig. 3-2, all of the feature cards have been removed so that the mother board is visible with its 5/7/8 system-bus card slots shown empty.

THE POWER SUPPLY

The power supply is housed in the System Unit. It is shown at the top right corner in Fig. 3-2. This power supply provides Direct Current (DC) power to the elements of the System Unit. The power supply also provides AC power to the monochrome display. This power supplys four DC power levels +5 volts and +12 volts. These power levels are available at the 5 system-bus slots and can be used by feature cards. A total of watts of DC power is available to the system and its features 65/100/130.

THE DISKETTE DRIVES

The System Unit can house up to two 5-¼ inch floppy diskette drives. At this time, it has two capacity sizes. One is a single-sided drive with approximately 160KB of storage and the other is a double-sided drive with approximately 320KB of storage. Thus, if two double-sided drives were installed in the System Unit, a total of 640 kilobytes of storage is available within the unit. To attach the two diskette drives, a diskette adapter must be installed in one of the 5/7/8 system-bus slots. The 16-bit PC/XT diskette-drive adapter has an external port that provides the signals for attaching two drives outside of the System Unit.

THE SPEAKER

Housed near the front left corner of the System Unit is a small audio speaker. The speaker is under program control and, typically, it is used as an alarm or as an output device for games and application programs that require an audio output.

THE SYSTEM KEYBOARD

The **16BIT** PC/XT KEYBOARD is a 83-key full-function keyboard with a central body similar to that of a standard typewriter keyboard. There are extra keys on each side of the standard typewriter section, however, on the left, there are two columns of 5 keys that are program function keys. The key functions are defined by the system or application program being executed in the system. On the right side of the keyboard, an array of keys are available that we are used to perform the dual functions of numeric data entry and cursor control. Fig. 3-3 is a picture of the system keyboard that clearly illustrates its layout. The keyboard interfaces to the system Unit via a fourwire interface that contains both signal and power leads. The keyboard sends a unique 8-eit scan code on both a key depression and on a key release. If a key is held down, the keyboard sends a scan code on the depression, pauses, and then sends the same scan code at a fixed typomatic rate until the key is released. Upon release of the key, a different scan code is sent. This function allows applications to define the mode of operation of the keyboard and, also, define the shift states and the typomatic functions of each key on the keyboard.

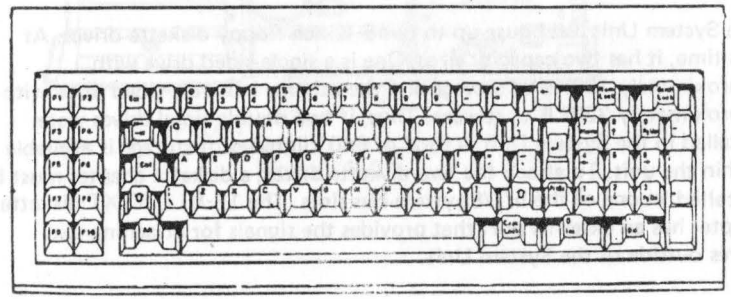


Figure: 3-3

THE FEATURE CARDS

The PC/XT presently offers a set of feature cards that fit into the 5/7/8 system-bus slots to provide memory expansion, drive attachment, and standard interfaces for a variety of devices and purposes.

** DISKETTE DRIVE ATTACHMENT ADAPTER CARD **

This feature card allows the attachment of two 5¼ inch diskette drives internal to the System Unit and two external drives. It takes one slot in the System Unit. The card is capable of supporting both single-and-double side diskettes in double-density format.

** PARALLEL PRINTER PORT ATTACHMENT CARD **

This card allows the attachment of most printers, that use the industry standard Centronix parallel interface. It is capable of supporting both programmed data transfer and interrupt-driven data transfer. The attachment card could fit in one of the 5/7/8 system-bus card slots.

** COLOR GRAPHICS DISPLAY ADAPTER CARD **

This card provides the ability to attach a variety of TV-frequency monitors and display. It supports both monochrome and color in both text and graphic modes. In text mode, it supports either a 40X25 or a 80X25 display format. Also, in the text mode, each character is formed in an 8X8 character box, characters can be monochrome or they can be displayed in color with 8 background colors and 16 foreground colors. Each of the character in the text mode can also be made to blink, multiple pages of text may also be stored in the adapter, as four 80X25 screens or eight 40X25 screens.

The adapter card has two graphics modes – a 320X200 four-color mode and a 640X200 monochrome mode. In the 320X200 mode, each dot on the screen can be programed with one of four colors. Two sets of four colors are available. The 640X200 mode is only supported in monochrome since all of the 16KB on-card memory is used to represent the ON, OFF state of the dots, leaving no memory to represent color information.

The graphics display adapter can support three different display interfaces – a direct drive, a composite video, and an RF modulator. The RF modulator interface allows through the use of an external RF modulator device, attachment to a standard home TV set. The adapter will also support a light pen input device.

The display adapter card contains a ROM character generator that provides 256 characters for display on the screen. In addition to the standard 96 ASCII characters, there are special characters for supporting games and text processing, plus international characters and symbols, line graphics, and scientific notation and Greek characters.

The color graphics adapter card fits the System Unit and takes one of the system-bus card slots.

** MONOCHROME DISPLAY ADAPTER AND **
** PARALLEL PRINTER PORT ADAPTER CARD **

This card is a combination adapter, supporting two function, the attachment of the PC/XT monochrome display and providing a parallel printer port. The display portion of this card supports a text only 80X25 screen format on the monochrome display. The character set is the same character set that is used on the color graphic adapter card, but it's styled in a larger font, to take advantage of the higher performance of the monochrome display, characters are formed in a 9X14 character box and each character can be highlighted, underlined, blinked, and reversed from green-on-black be used to attach to the monochrome display. In GRAPHICS mode, the bits is the buffer control the actual dots on the screen, screen patterns are formed by writting "1"S and "0"S to the buffer, the buffer is organized as two complete screens that can be alternately displayed. This feature makes it possible to compose one pattern while displaying another, which is particularly useful for animation the monochrome graphics with an enhanced function of 720X348 graphics on a monochrome monitor.

The parallel printer port portion of this card is identical to the parallel printer port attachment card described elsewhere in this manual. This adapter card fits in the System Unit and uses one of the 5/7/8 system-bus card slots.

4 SYSTEM BOARD INSTRUCTION

Section I

THE SYSTEM BOARD

The PC/XT system board fits horizontally in the base of the system unit and is approximately 8½×12 inches. It is a double sided P.C.B.,DC power and a signal from the power supply enter the board through two six-pin connectors. Other connectors on the board are for attaching the keyborad and speaker. Eight 62-pin card edge-sockets are also mounted on the board. The I/O channel is bussed across these eight I/O slots.

A "Dual-in-Line Package (DIP) switch (SWI) (one eight-switch pack) is mounted on the board and can be read under program control. The DIP switch provides the system software with information about the installed options, how much storage the system board has, what type of the display adapter is installed, what operation modes are desired when power is switched on (color or black-and-white, 80- or 40-character lines), and the number of diskette drive attached.

The system board consists of five functional area: the processor subsystem and its support elements, the Read-Only Memory (ROM) subsystem, the Read/Write (R/W) Memory subsystem, integrated I/O adapters, and the I/O channel. All are desired in this section.

The heart of the PC/XT system board is the Intel 8088 microprocessor. This processor is an 8-bit external bus version of Intel's 16-bit 8086 processor, and it's software-compatible with the 8086. Thus, the 8088 supports 16-bit operations, including multiply and divide, and supports 20 bits addressing (1 megabyte of storage). It also operates in a maximum mode, so a coprocessor can be added as a feature. The processor operates at a 4.77 MHz. This frequency, which is derived from a 14.318 MHz crystal, is divided by 3 for the processor clock, and by 4 to obtain the 3.58 MHz color burts signal required for color televisions.

At the 4.77 MHz colck rate, the 8088 bus cycles are four clocks of 210 ns, or 840 ns. I/O cycles take five 210 ns clocks or 1.05 microseconds.

The processor is supported by a set of high-function devices providing four channels of 20-bit Direct-Memory Access (DMA), three 16-bit timer-counter channels, and eight prioritized interrupt levels.

Three of the four DMA channels are available on the I/O bus and support high speed data transfers between I/O devices and memory without processor intervention. The fourth DMA channel is programmed to refresh the system dynamic memory. This is done by programing a channel of the timer-counter device to periodically request a dummy DMA transfer. This action creates a memory-read cycle, which is available to refresh dynamic storage, both on the system board and in the system expansion slots. All DMA data transfers, except the refresh channel, take five processor clocks of 210 ns, or 1.05, μs if the processor-ready line is not deactivated. Refresh DMA cycles take four clocks or 840 ns.

The three programmable timer/counters are used by the system as follows: Channel 0 is used as a general purpose timer, providing a constant time base for implementing a time-of-day clock; Channel 1 is used to time and request refresh cycles from the DMA channel; and Channel 2 is used to support the tone generation for the audio speaker. Each channel has a minimum timing resolution of 1.05 μs.

Of the eight prioritized levels of interrupt, six are bussed to the system expansion slots for use by features cards. Two levels are used on the system board. Level 0, the highest priority, is attached to Channel 0 of the timer/counter and provides a periodic interrupt for the time-of-day clock. Level 1 is attached to the keyboard adapter circuits and receives an interrupt for each scan code sent by the keyboard. The Non-Maskable Interrupt (NMI) of the 8088 is used to report memory parity errors.

The system board supports both ROM/EPROM and R/W memory. It has space for 128K x 8 of ROM or EPROM. This ROM contains the power-on self-test, I/O drivers, dot patterns for 128 characters in graphics mode, and a diskette and has an access time and a cycle time of 250 ns each.

The system board also has from 128K 9 to 256K 9 of R/W memory. A minimum system would have 128K of memory, with module sockets for an additional 128K. Memory greater than the system board has a maximum of 256K, is obtained by adding memory cards in the expansion slots. The memory consists of dynamic 64K 1 chips with an access time of 200 ns and a cycle time of 345 ns. All R/W memory is parity checked.

The system board contains the adapter circuits for attaching the serial interface from the keyboard. These circuits generate an interrupt on to the processor, when a complete scan code is received. The interface can request execution of a diagnostic test in the keyboard.

The keyboard interface is a 5-pin DIN connector on the system board, that extends through the rear panel of the system unit.

The system units has an 2¼ inch audio speaker. The speaker's control circuits and driver are on the system board. The speaker connects through a 2-wire interface that attaches to a 3-pin connector on the system board.

The speaker drive circuit could be capable of providing approximately ½ watt of power. The control circuits allow the speaker to be driven three different ways: 1) a direct program control register bit may be toggled, to generate a pulse train; 2) the output from Channel 2 of the timer counter, may be programed to generate a waveform to the speaker; 3) the clock input to the timer counter, can be modulated with a program controlled I/O register bit. All three methods may be performed simultaneously.

Section II

I/O Channel

The I/O channel is an extension of the 8080 microprocessor bus. It is, however, demultiplexed, repowered, and enhanced by the addition of interrupts and Direct Memory Access (DMA) functions.

The I/O channel contains an 8 bit, bidirectional data bus, 20 address lines, 6 levels of interrupt, control lines for memory and I/O read or write, clock and timing lines, 3 channels of DMA control lines, memory refresh timing control lines, a channel check line, and power and ground for the adapters. Four voltage levels are provided for I/O card: +5 Vdc, –5 Vdc, +12 Vdc, and –12dc. These functions are providcded in a 62-pin connector with 100-mil card tab spacing.

A "ready" line is available on the I/O channel, to allow operation with slow I/O or memory devices. If the channel's ready line is not activated by an addressed device, all processor-generated memory read and write cycles takes four 210-ns clock or 840-ns/byte. All processor-generated I/O read and write cycles require five clocks for a cycle time of 1.05 μs/byte. Refresh cycles occur once every 72 clocks (approximately 15 μs) and require four clocks or approximately 7% of the bus bandwidth.

I/O devices are addressed using I/O mapped address space. The channel is designed so that 768 I/O device addressed are available to the I/O channel cards.

A channel check line exists for reporting error conditions to the processor. Activating this line results in a Non-Maskable Interrupt (NMI) to the 8088 processor. Memory expansion options use this line to report parity errors.

The I/O channel is repowered, to provide sufficient drive, to power all eight (J1 through J8) expansion slots, assuming two Low-Power Sohorttky (LS) loads per slot. The I/O adapters typically use only one load.

Section III

I/O Channel Description

The following is a description of the PC/XT I/O Channel. All lines are TTL-compatible.

Singal I/O Description

OSC , Oscillator:
High; speed clock with a 70-ns period (14.31818 MHz). It has a 50% duty cycle.

CLK , System Clock:
It is divide-by-three of the oscillator and has a period of 210 ns (4.77 MHz). The clock has a 33% duty cycle.

RESET :
This line is used to reset or initialize system logic upon power-up or during a low line voltage outage. This signal is synchronized to the falling edge of clock and is active high.

AO-A19 , Address Bits 0 to 19:
These lines are used to address memory and I/O devices within the system. The 20 address lines allow access of up to 1 megabyte of memory. AO is the Least Significant Bit (LSB) and A19 is the Most Significant Bit (MSB). These lines are generated by either the processor or DMA controller. They are active high.

DO-D7,I/O Data Bits 0 to 7:
These lines provide data bus bits 0 to 7 for the processor, memory, and I/O devices. DO is the Least Significant Bit (LSB) and D7 is the Most Significant Bit (MSB). These lines are active high.

ALE , Address Latch Enable:
This line is provided by the 8288 Bus Controller and is used on the system board to latch valid addresses from the processor. It is available to the I/O channel as an indicator of a vilid processor address (when used with AEN). Processor addresses are latched with the failing edge of ALE.

I/O CH CK , I/O Channel Check:
This line provides the processor with parity (error) information on memory or devices in the I/O channel. When this signal is active low, a parity error would indicated.

I/O CH RDY , I/O Channel Ready:
This line, normally high (ready), can be pulled low (not ready) by a memory or I/O device to lengthen I/O or memory cycles. It allows slower devices to attach to the I/O channel with a minimum of difficulty. Any slow device using this line should drive it low immediately upon detecting a valid address and a read or write command. This lines should never be held low, longer than 10 clock cycles. Machine cycles (I/O or memory) are extended by an integral number of CLK cycles (210 ns).

IRQ2-IRQ7 , Interrupt Request 2 to 7:
These lines are used to signal the processor, that a I/O device requires attention. They are prioritized with IRQ2 as the highest priority and IRQ7 as the lowest. An Interrupt Request are generated by raising an IRQ line (low to high) and holding it high, until it was acknowledged by the processor (interrupt service routine).

IOR , I/O Read Command:
This command line instructs an I/O device to drive its data onto the data bus. It may be driven by the processor or the DMA controller. This signal is active low.

IOW , I/O Write Command:
This command line instructs an I/O device, to read the data on the data bus. It may be driven by the processor or the DMA controller. This signal is active low.

MEMR , Memory Read Command:
This command line instructs the memory to drive its data into the data bus. It may be driven by the processor or the DMA controller. This signal is active low.

MEMW , Memory Write Command:
This command line instructs the memory to store the data present on the data bus. It may be driven by the processor or the DMA controller. This signal is active low.

DRQ1-DRQ3 , DMA Request 1 to 3:
These lines are asynchronous channel requests used by peripheral devices to gain DMA service. They are prioritized with DRQ3 being the lowest and DRQ1 being the highest. A request is generated by bringing a DRQ line to an active level (high). A DRQ line must be held high until the corresponding DACK line goes active.

DACKO – 3 – DMA Acknowledge 0 to 3:
These lines are DACK3 used to acknowledge DMA requests (DRQ1-DRQ3) and to refresh system dynamic memory (DACKO). They are active low.

AEN , Address Enable:
This line is used to degate the processor and other devices from the I/O channel to allow DMA transfers to take place. When this line is active (high), the DMA controller has control the address bus, data bus, read command lines (memory and I/O), and the write command lines (memory and I/O).

T/C , Terminal Count:
This line provides a pulse when the terminal count for any DMA channel is reached. This signal is active high.

CARD SLCTD , Card Selected:
This line is activated by cards in expansion slot J8. It signals, "THE SYSTEM BOARD", that the card has been selected and that appropriate drivers on the system board should be directed to either read from, or write to, expansion slot J8. Connectors J1 through J8 are tied together at this pin, but the system board should be driven by an open collector device.

The following voltages are available on the system board I/O channel:

+5 Vdc + – 5%, located on 2 connector pins
–5 Vdc + –10%, located on 1 connector pin
+12 Vdc + – 5%, located on 1 connector pin
–12 Vdc + –10%, located on 1 connector pin
GND (Ground), located on 3 connector pins

Section IV

Speaker Interface

The sound system has a small, permanent-magnet, 2¼ inch speaker. The speaker can be driven from one or two sources:

* An 8255A-5 PPI output bit. The address and bit are defined in the "I/O Address Map".
* A timer clock channel, the output of which is programmable within the founctions of the 8253-5 timer when using a 1.19-MHz clock input. The timer gate also is controlled by an 8255A-5 PPI output-port bit. Address and bit assignment are in the "I/O Address Map".

The speaker connection is a 4-pin berg connector. See "System Board Component Diagram", earlier in this section, for speaker connection or placement.

Section V

The system board Switch Setting

The DIP Switch (SW1) located at U20 is used to set the system configuration and specify the amount of memory installed on the system board.

Position	Function
1	Normal operation off
2	Use for 8087 co - processor
3-4	Amount of memory on system board
5-6	Type of display adapter
7-8	Number of 5¼ inch diskette drives

Switch (SW1):
1 = OFF (NORMAL OPERATIORN)
2 = ON W/O 8087 co-processor
2 = OFF W/O 8087 co-processor

Memory Switch Settings:
3 = OFF 4 = ON 128K MEMORY INSTALLED
3 = ON 4 = OFF 192K MEMORY INSTALLED
3 = OFF 4 = OFF 256K MEMORY INSTALLED

Display Adapter Switch Settings:
5 = ON 6 = ON NO DISPLAY ADAPTER
5 = OFF 6 = ON COLOR/GRAPHICS (40X20 Mode)
5 = ON 6 = OFF COLOR/GRAPHICS (80X25 Mode)
5 = OFF 6 = OFF MONOCHROME DISPLAY ADAPTER OR BOTH

Display Dirve Switch Setting:
7 = ON 8 = ON 1 DRIVE INSTALLED
7 = OFF 8 = ON 2 DRIVES INSTALLED
7 = ON 8 = OFF 3 DRIVES INSTALLED
7 = OFF 8 = OFF 4 DRIVES INSTALLED

Section VI

PC/XT EPROM/ROM Switch Settings:

The System board will accept 4 different type of ROM/EPROM for the system memory.

The switch settings are as follow:

W	1	2	3	4	5	6	7	8	9	10	11	12
2764 EPROM	1	0	1	0	1	0	1	0	0	1	0	1
27128 EPROM	1	0	0	1	1	0	1	0	1	0	0	1
8Kx8 ROM	1	0	1	0	0	1	0	1	0	1	0	1
23Kx8 ROM	0	1	0	1	1	0	1	0	1	0	1	0

NOTE: 1 = ON 0 = OFF

W1 – W8 is located next to U35 (ROM 7)
W9 – W12 is located above U24 (74LS02)

The memory decoder (U23 & 74LS02) must position in the right place as follows:

Position A: 2764 EPROM or 8Kx8 ROM
B: 27128 EPROM
C: 32Kx8 ROM

NOTE: EPROM's pin out must be Intel compatible with access time not more than 250ns. ROM7 has the highest address.

Section VII

Power Up Reset Jumper: (JP1)

The IBM Power Supply provides a Power Good' signal from the power supply PIN 1. If you use an IBM power supply, insert a jumper on, JP1 from 1 to 2, or connect Jumper JP1 from 2 to 3 which will provide a power up reset circuit on board.

Section VIII

Some Trouble Shooting Points

This section give some hints to experienced engineers and technicians to test and bring up the Super XT system board.

1) System Clock:
4.77 MHz at U1 (8284A) PIN 8 and U3 (8088) PIN 10, etc., with 33% duty cycle. If no system clock, check Y1 (14.318MHz) crystal, U1.

2) Power Up Reset:
When Power up U3 (8088) PIN 21 should go high then back to low again. If no power up, please check jumper on JP1.

3) Memory Decoding Circuit:
When power up, the processor will start execute the program through ROM 7 (BIOS & Self Test). The CS7 – line should see a train low again pulses to fetch instruction from the ROM 7. If no pulses on CS7 – on U23 (LS138 PIN 7), check the memory decoding circuit and make sure the ROM/EPROM Jumpers (W1-W12) are in the right position.

4) RAM Refresh:
The RAM is being refresh using the timer chip U49 (8253-5 PIN 13 OUT 1) to trigger the chip (8237A-5) DRQO, and the DMA chip will send out a dummy address to refresh the dynamic RAMs (4164). If no periodic low pulses on RAM chip PIN 4 (RAS–), check the TIMER, DMA, and refreshing circuit.

5) R.T.C. Circuit:
A square wave is generated through TIMER/COUNTER CHIP (8253-5U49) PIN 10 (OUT 0), and then interrupt the processor through 8259A PIN 17 (INT Signal) for the R.T.C. Timing.

6) Keyboard Circuit:
The keyboard data input is through keyboard connector PIN 2 and U22 (LS322) to convert the serial data to parallel and read by 8255A-5 (U37) port A. Interrupt 1 (ITQ 1) is used to inform the processor, that a key had been pressed. If no keyboard response, check U52 (74LS74), U22 (LS322), and U37 (8255A-5).

NOTE: The PC/XT system board will run with the IBM XT ROM set (32Kx8), but will not run with the IBM PC ROM set (8Kx8).

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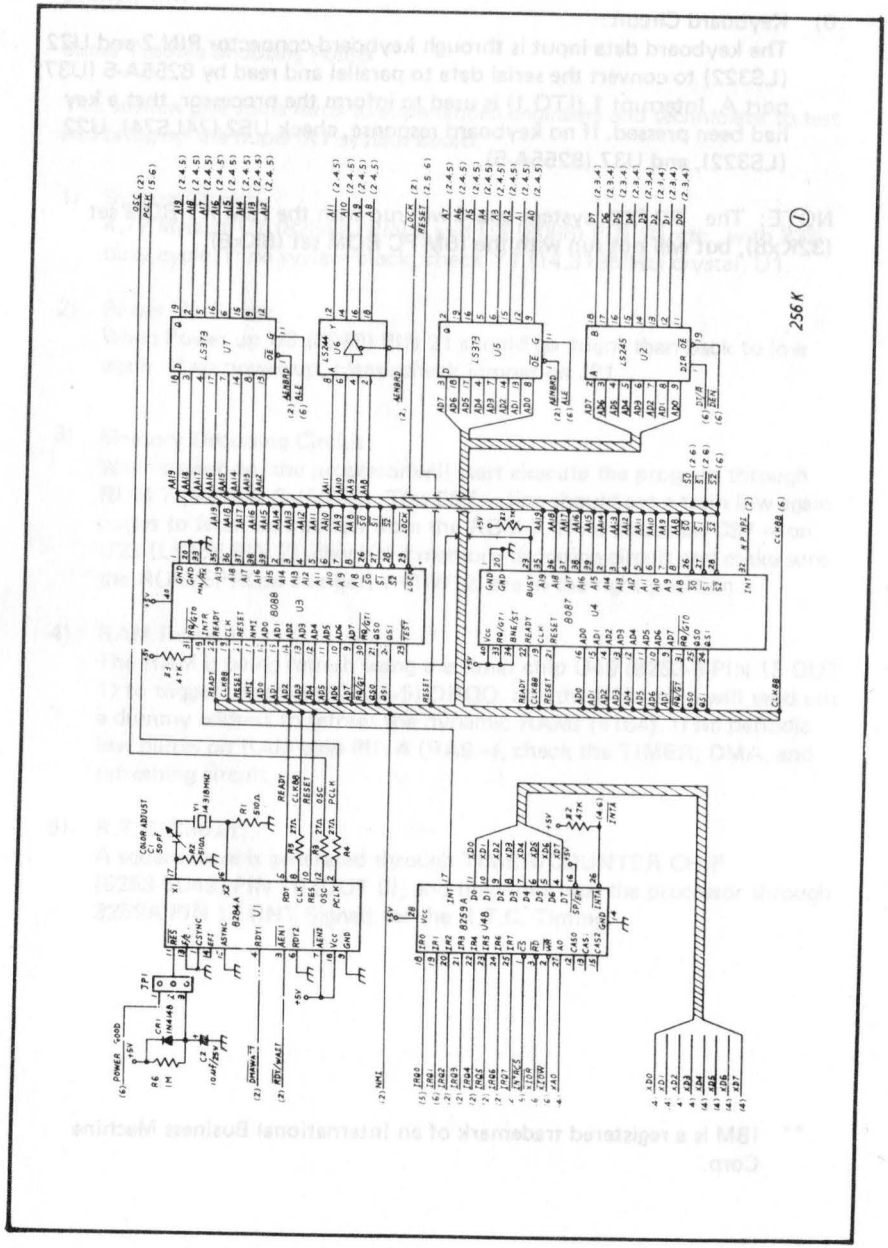
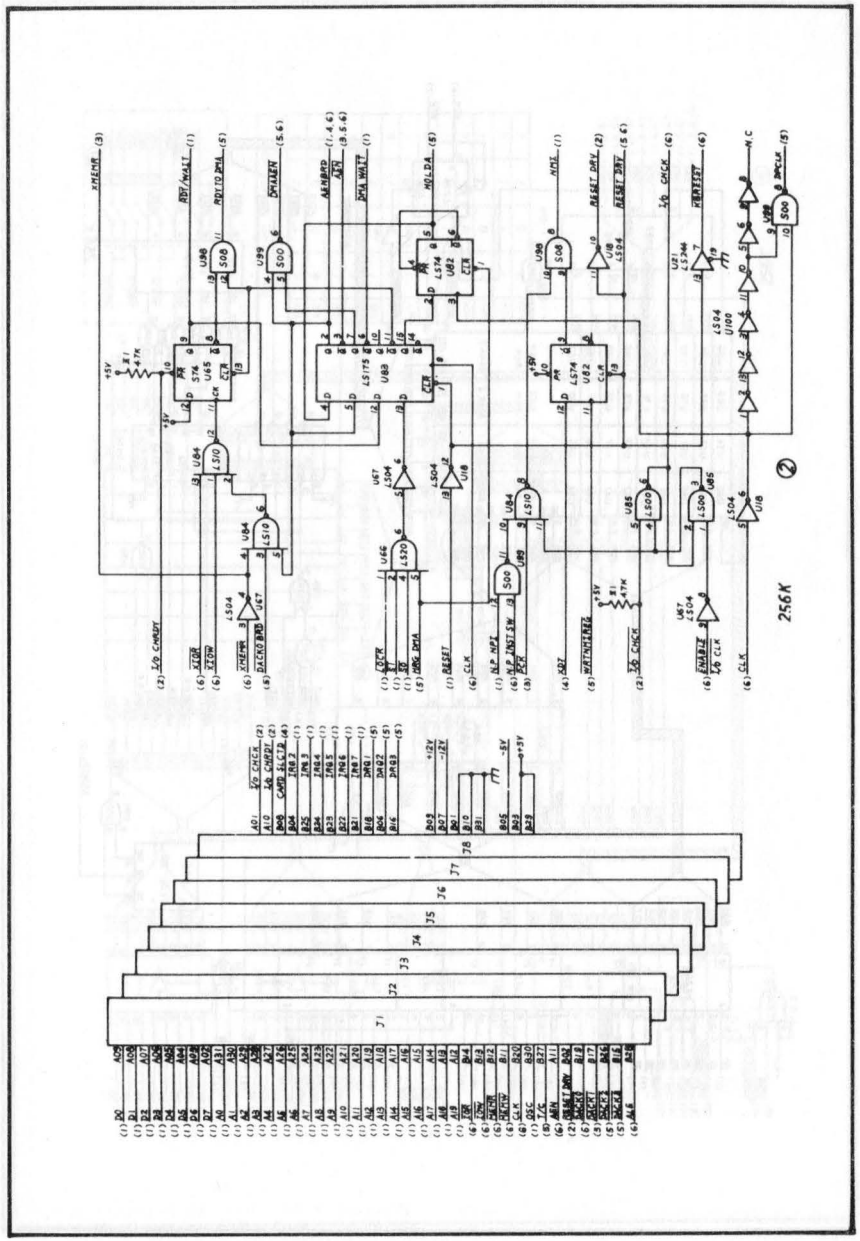
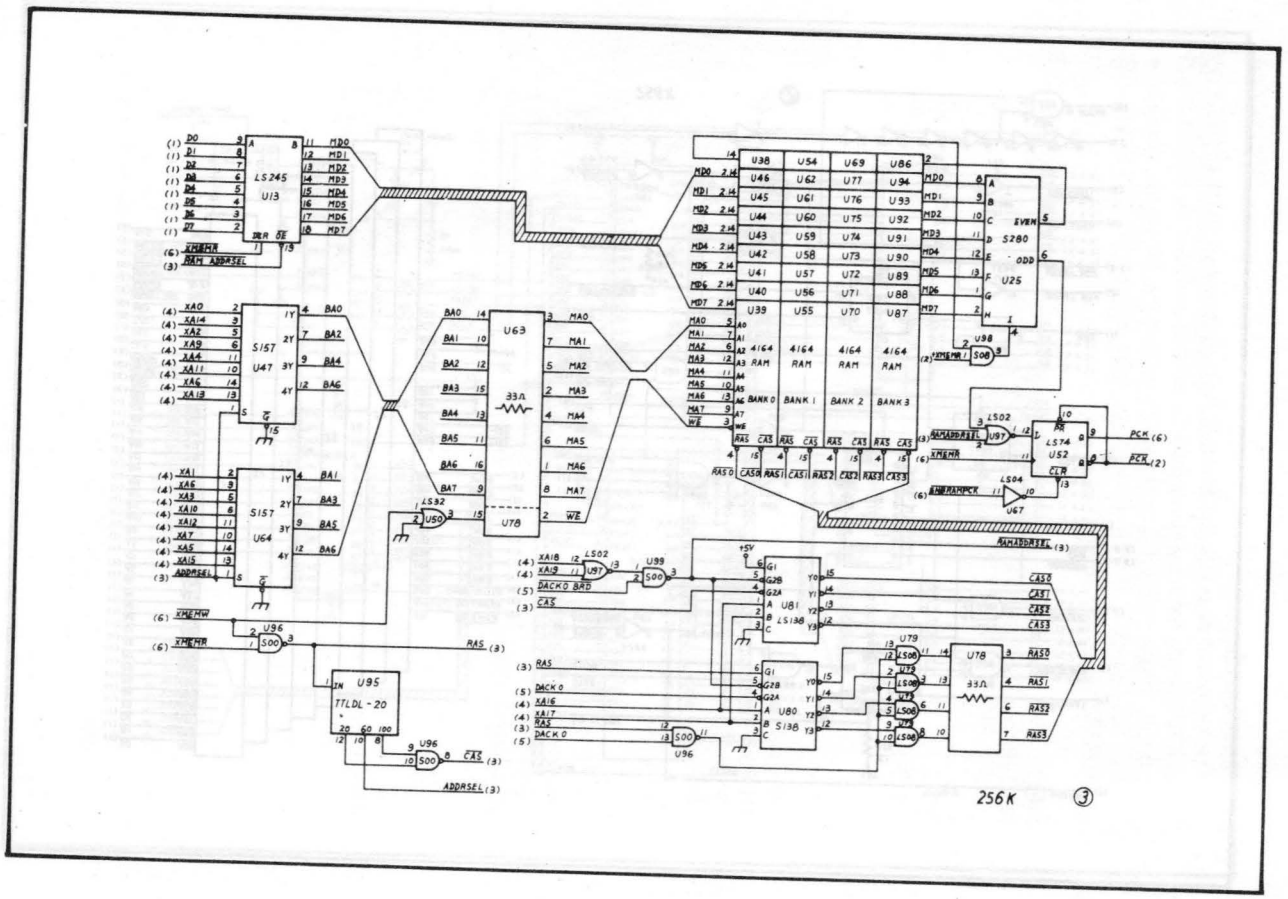


SHEET 1 OF 6



SHEET 2 OF 6

SHEET 3 OF 6



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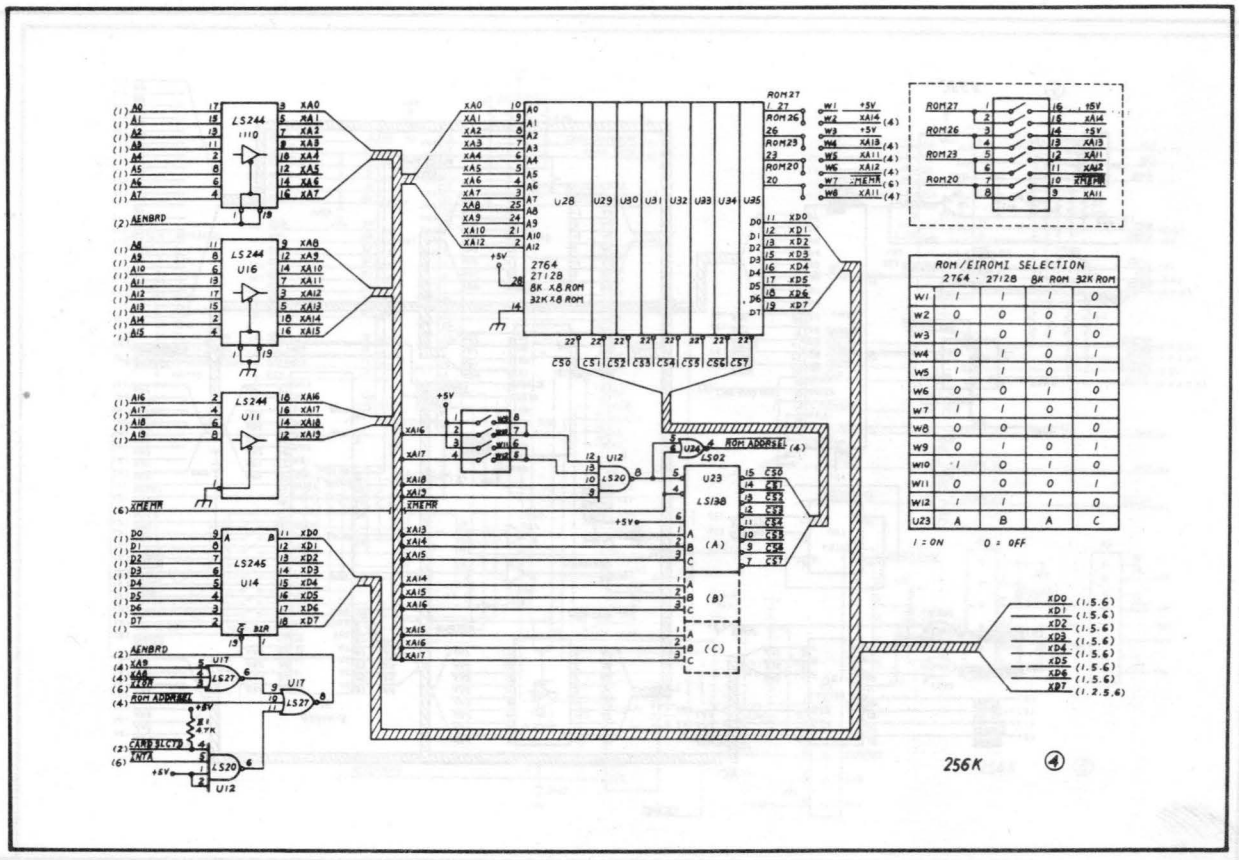
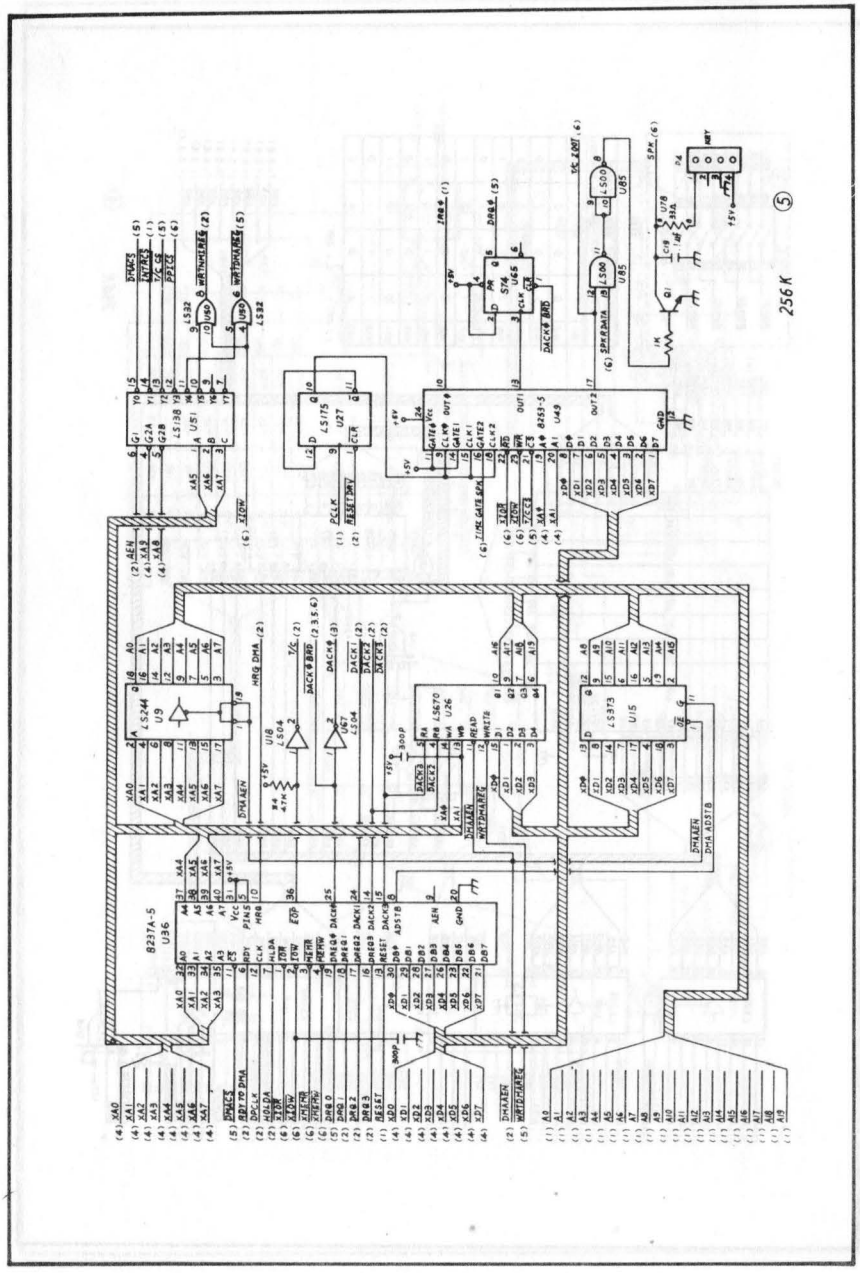
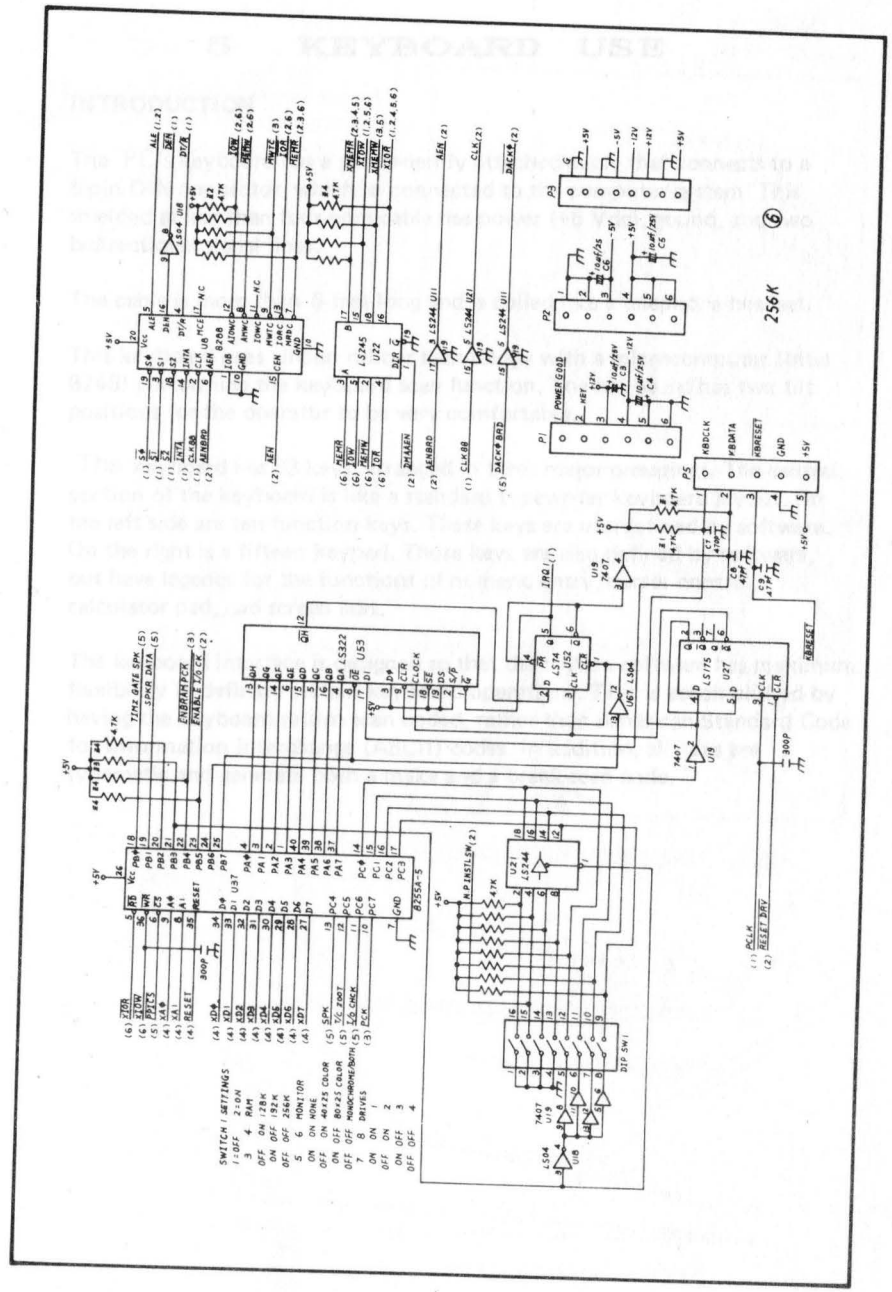




SHEET 5 OF 6



SHEET 6 OF 6

5 KEYBOARD USE

INTRODUCTION

The PC's keyboard has a permanently attached cable that connects to a 5-pin DIN connector, which is connected to the computer system. This shielded at less than four-wire cable has power (+5 Vdc), gound, and two bidirectional signal lines.

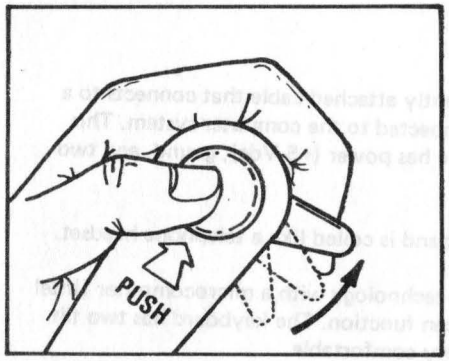
The cable is more than 6-feet long and is coiled like a telephone headset.

This keyboard uses silicon rubber technology with a microcomputer (Intel 8748) performing the keyboard scan function. The keyboard has two tilt positions for the operator to be very comfortable.

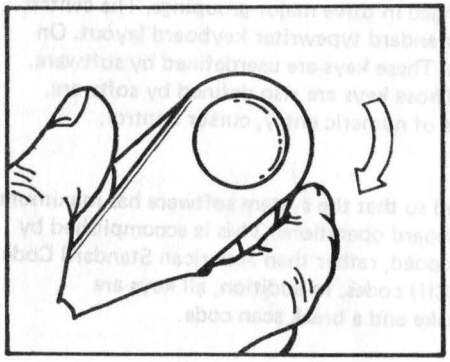
The keyboard has 83 keys, arranged in three major groupings. The central portion of the keyboard is like a standard typewriter keyboard layout. On the left side are ten function keys. These keys are userdefined by software. On the right is a fifteen keypad. Those keys are also defined by software, but have legends for the functions of numeric entry, cursor control, calculator pad, and screen edit.

The keyboard interface is designed so that the system software has maximum flexibility in defining certain keyboard operations. This is accomplished by having the keyboard return scan coded, rather than American Standard Code for Information Interchange (ASCII) codes. In addition, all keys are typematic and generate both a make and a break scan code.

KEYBOARD
ADJUSTMENT

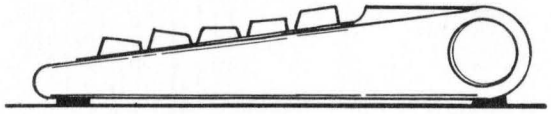


There is one adjustable leg located at each end of the keyboard, there-by offering the option between two positions to ensure typing comfort.

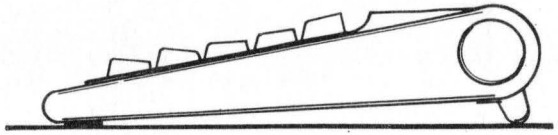


Pull back the adjustable leg.

CAUTION: HOLD KEYBOARD WHEN CHANGING POSITION

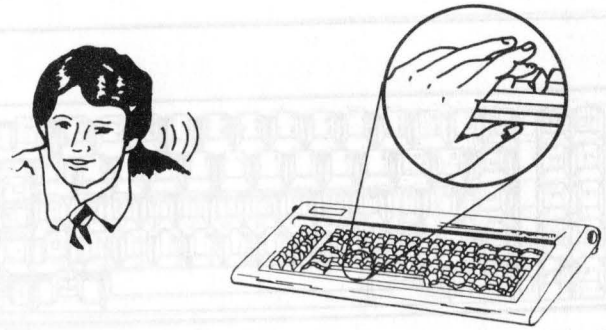


Keyboard in tilt position.



Keyboard in lever position.

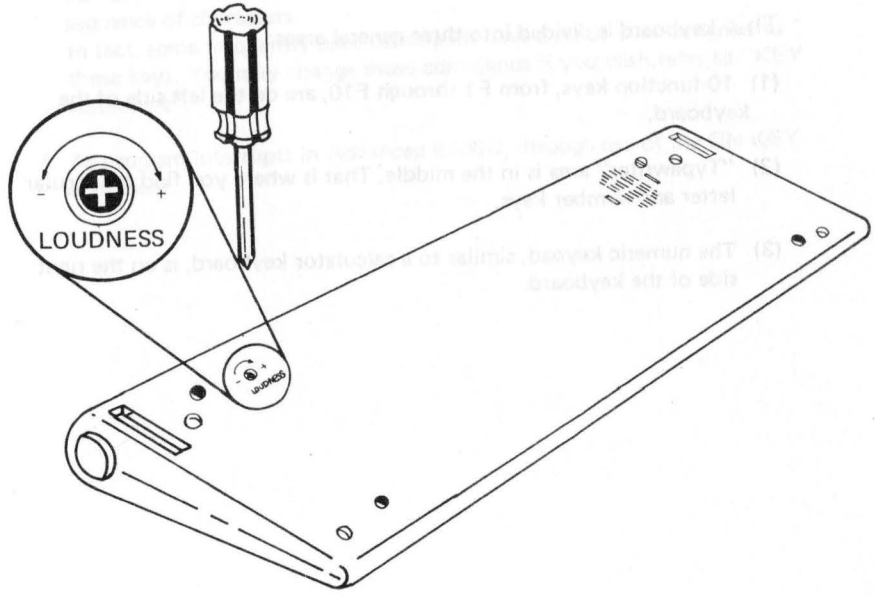
CONTROL
THE LOUDNESS
OF KEY-BEEP



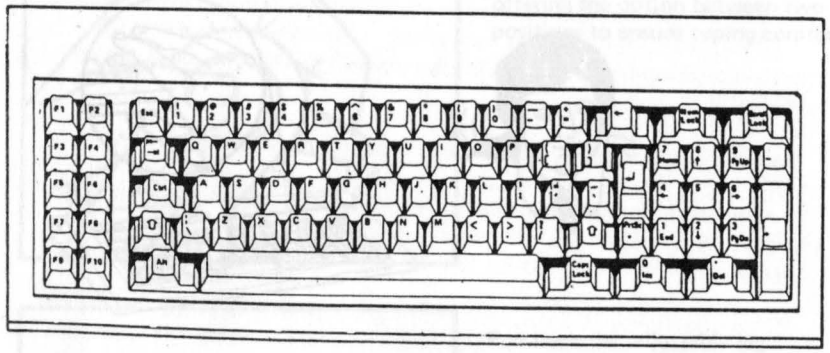
See catalog, when any key is presseed, the keyboard generates a short beep.

In this keyboard, the key-beep loudness can be just controlled by turning the loudness control screw with a philips screw driver.

The loudness switch screw is just in the back of keyboard.



The KEYBOARD



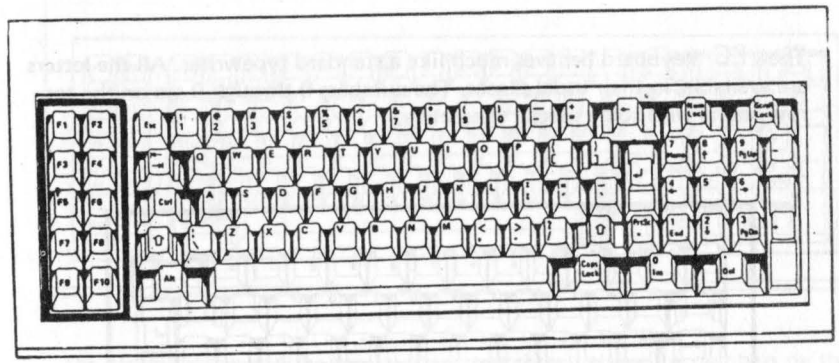
This keyboard is divided into three general areas:

(1) 10-function keys, from F1 through F10, are on the left side of the keyboard.

(2) "Typewriter" area is in the middle. That is where you find the regular letter and number keys.

(3) The numeric keypad, similar to a calculator keyboard, is on the right side of the keyboard.

FUNCTION KEYS



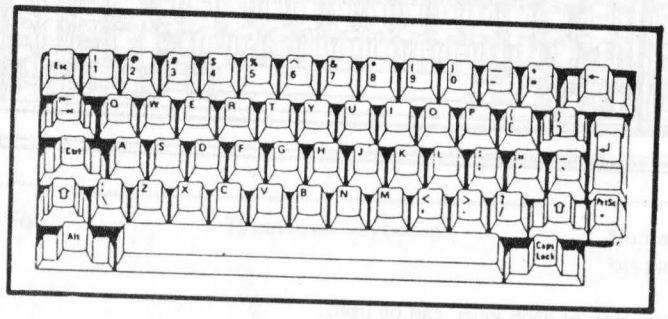
The function of each keys can be used:

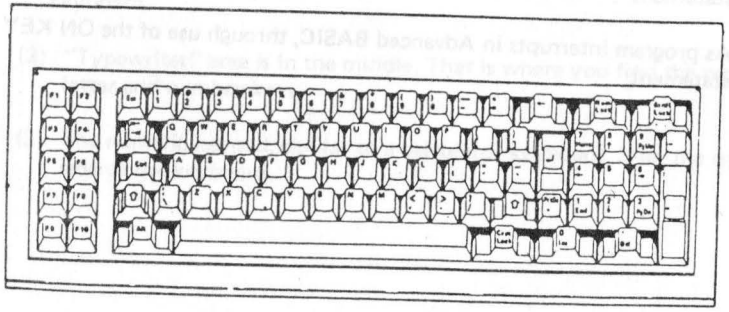
* As "soft keys". That is, you can get each key to automatically type any sequence of characters.
  In fact, some frequently-used commands have already been assigned to those keys. You may change those commands if you wish, refer to "KEY statement".

* As program interrupts in Advanced BASIC, through use of the ON KEY statement.

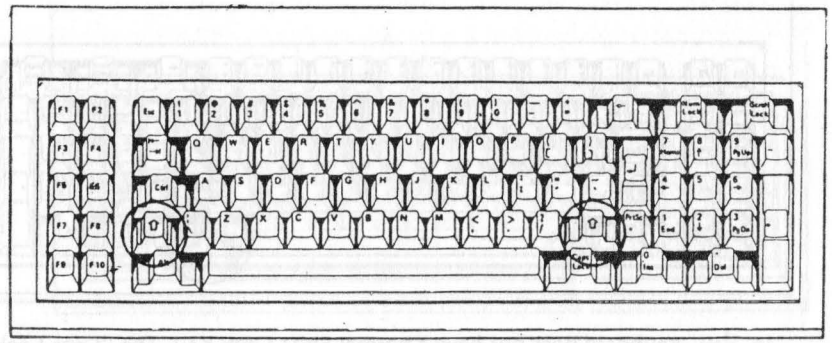
TYPEWRITER KEYBOARD

The PC keyboard behaves much like a standard typewriter. All the letters are available, in their usual places. The numbers 0 through 9 are on the top row, along with some special characters.



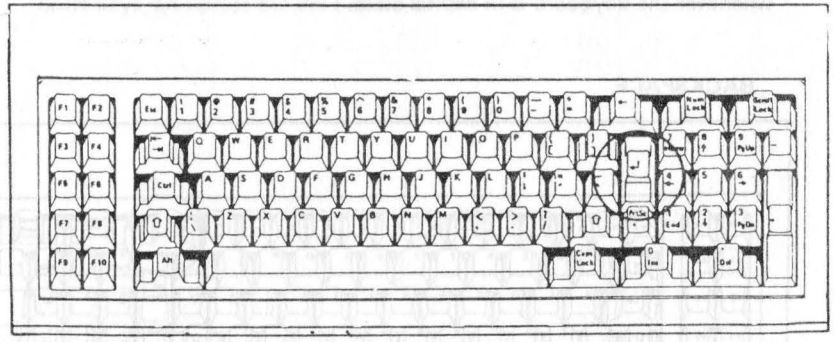


SHIFT



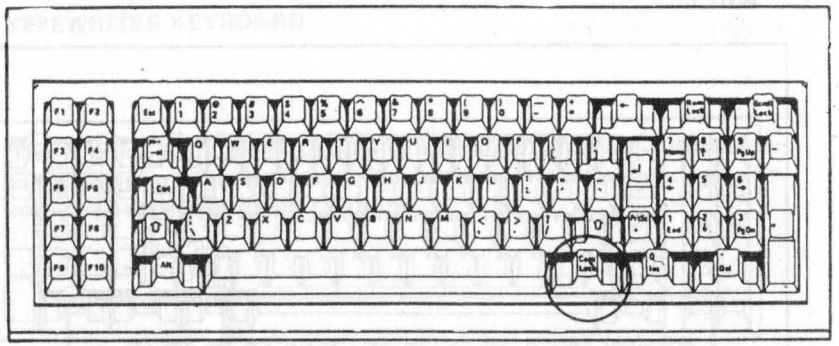
The capital letters and the special characters shown above the numbers on the number keys are displayed by holding down either of the ⇧ (shift keys) and pressing the desired key.

RETURN



The key with the ↵ symbol on it is the "carriage return" key. You usually have to press the key to "enter" information into the computer system. We will refer to it as the "ENTER" key. There are several important differences between PC keyboard and a regular typewriter, however.

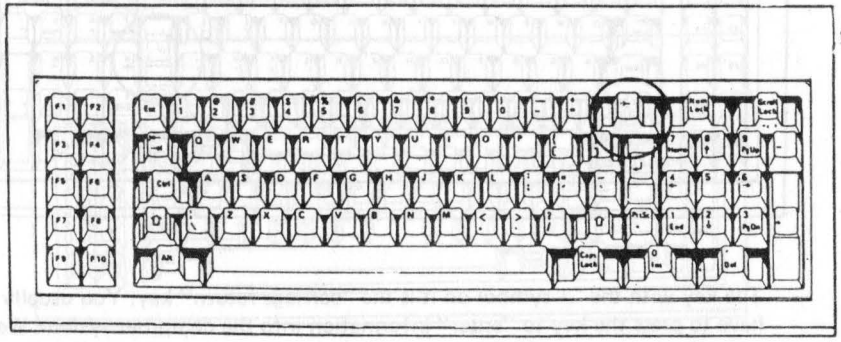
CAPS LOCK



In the keyboard does not have a normal Shift Lock Key. The "Caps Lock" key is similar to the Shift Lock Key, but it only gives you capital letters and will not give you the upper shift characters on the numeric or other keys. After you press this key, you will continue to get capital letters until you press it again.

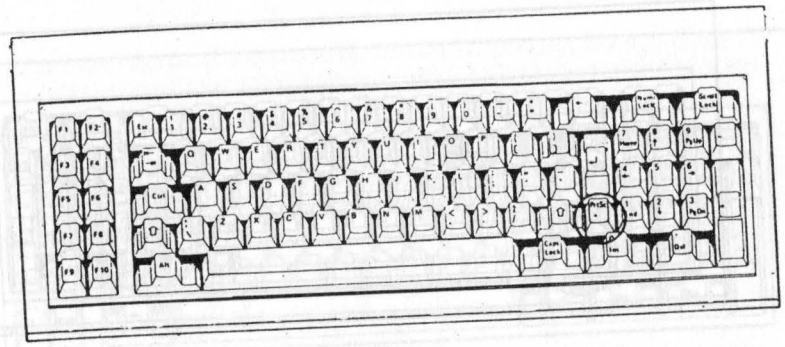
You could get the lowercase letters when in Caps Lock state by pressing and holding one of the "Shift" keys. When you release the Shift key, you will go back to Caps Lock state; "Caps Lock" is a toggle switch. The Caps LED lights whenever the keyboard is in capital state.

BACKSPACE



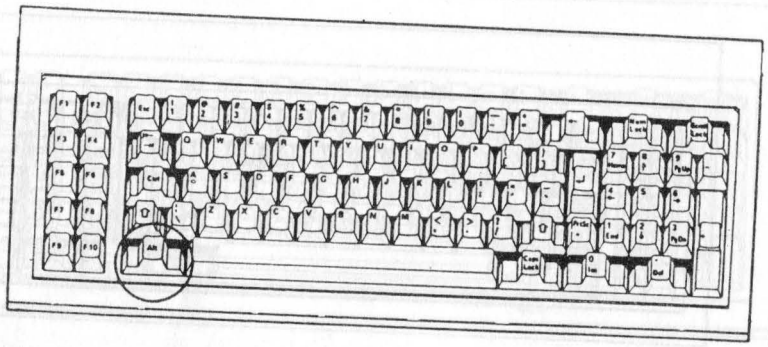
The PC's Back space key behaves somewhat differently from the Back space key on a regular typewriter. It doesn't only back spaces. but it erases what you have typed as well. You should use Cursor Left key to avoid erasing what you have typed.

PRT SC



Below the Return key is a key labeled Prt Sc on top and* on the bottom. "Prt Sc" stands for "Print Screen". When the keyboard is in lower shift, pressing this key causes an asterisk to be typed. In upper shift,however, this is a special key that causes a copy of what is on the screen to be printed on the printer (Getting a hard copy LPTI:). So if you ever need a hard (printed) copy of what is currently being displayed, just press and hold one of the Shift keys, and press the Prt Sc key.

ALT (Alternate)



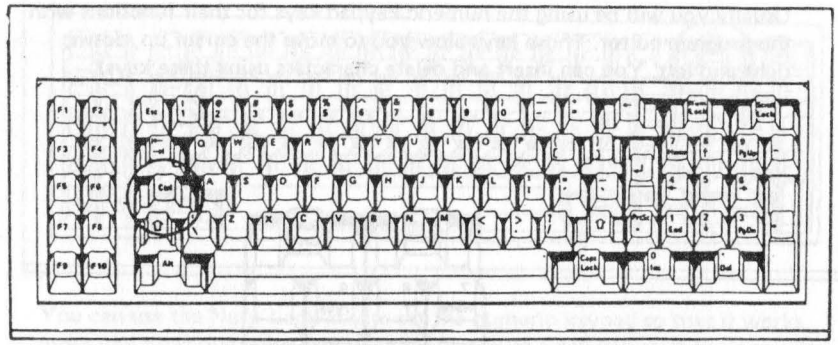
The Alt key enables easy entry of BASIC statement keywords. This key allows you to type an entire BASIC keyboard with a single keystroke. The BASIC keyword is typed, when the Alt key is held down, while one of the alphabetic keys A-Z is pressed. Keywords associated with each letter are summarized below. Letters not having reserved words are noted by "(not available)".

A	AUTO	N	NEXT
B	BSAVE	O	OPEN
C	COLOR	P	PRINT
D	DELETE	Q	(not available)
E	ELSE	R	RUN
F	FOR	S	SCREEN
G	GOTO	T	THEN
H	HEX	U	USING
I	INPUT	V	VAL
J	(not available)	W	WIDTH
K	KEY	X	XOR
L	LOCATE	Y	(not available)
M	MOTOR	Z	(not available)

The Alt key is also used with the keys on the numeric keypad to enter characters that could not be found on the keys. It is done by holding down the Alt key and typing the three-digit ASCII code for the character.

* See "Appendix keystrokes of Hex Value" *

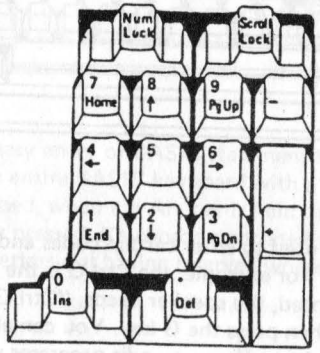
CTRL (Control)

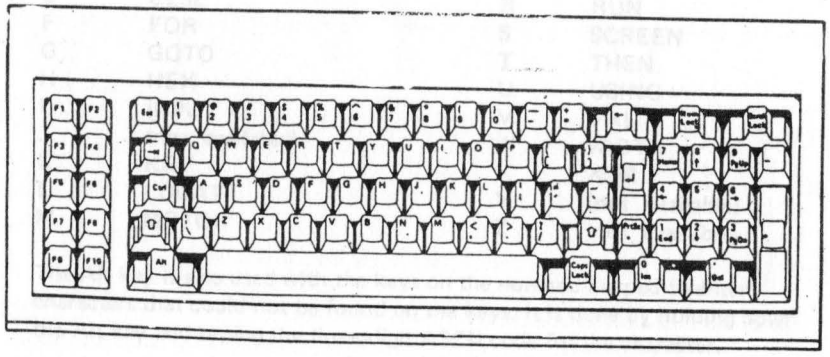


The Ctrl key is also used to enter certain codes and characters not available from the keyboard. For example; the Ctrl-G is the bell character and when this character is printed, the speaker beeps. "Ctrl-G" means you press and hold the Ctrl key, then press the G key. You can also use the Ctrl key together with other keys when you edit programs with the program editor.

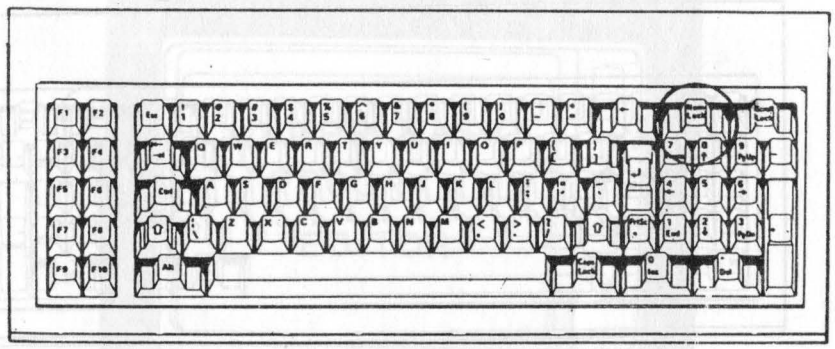
NUMERIC KEYPAD

Usually you will be using the numeric keypad keys for their functions with the program editor. Those keys alow you to move the cursor up, down, right and left. You can insert and delete characters using these keys.





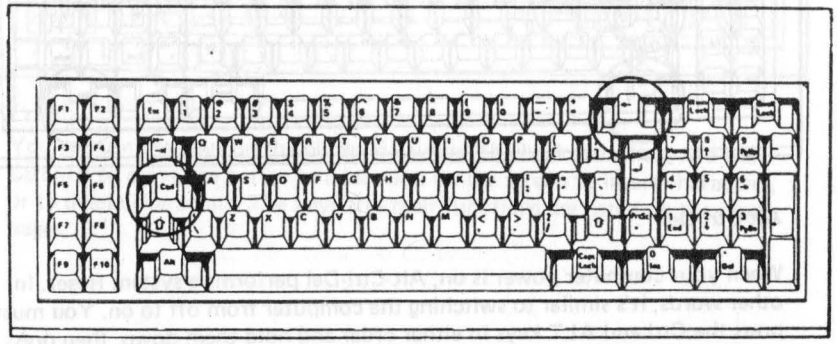
NUM LOCK



You can use the Num Lock key to set the numeric keypad so that it works more like a calculator keypad. Pressing the Num Lock key shift the numeric keypad into own up pershift mode, so that you get the numbers 0 through 9 and the decimal point, as indicated on the key tops. Pressing Num Lock again will return the keypad to its normal cursor control mode. Using Caps Lock, you can temporarily reverse the Num Lock state by pressing one of the Shift keys. The Num LED lights whenever the keyboard is in numeric keypad state.

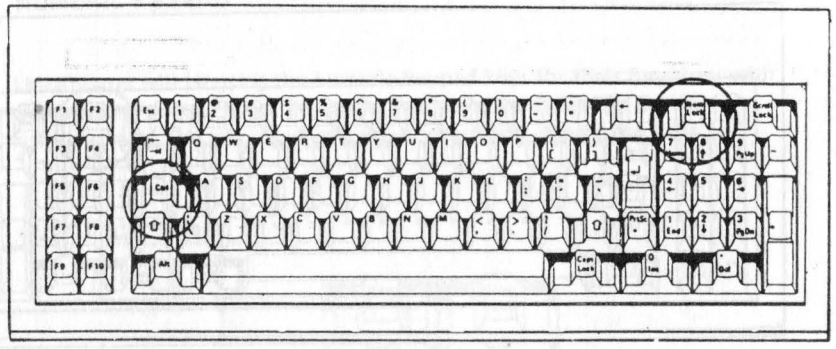
SOME SPECIAL KEY COMBINATIONS

One should be aware of some key combinations which have a very special Functions.



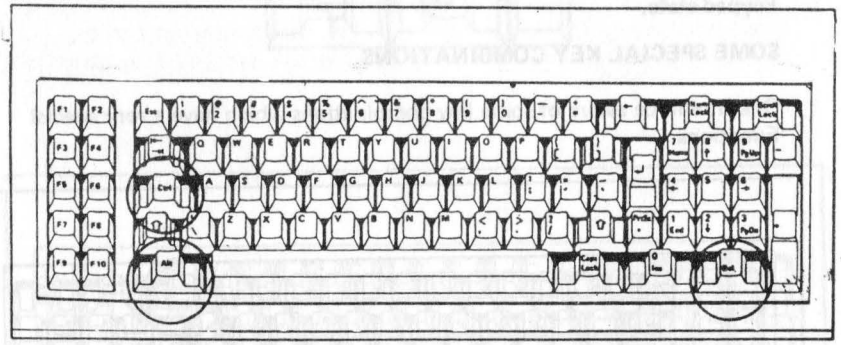
Ctrl-Break

Pressing both Ctrl & Break interrupts program execution at the next BASIC instruction and returns to BASIC command level. It is also used to exit AUTO line numbering mode.



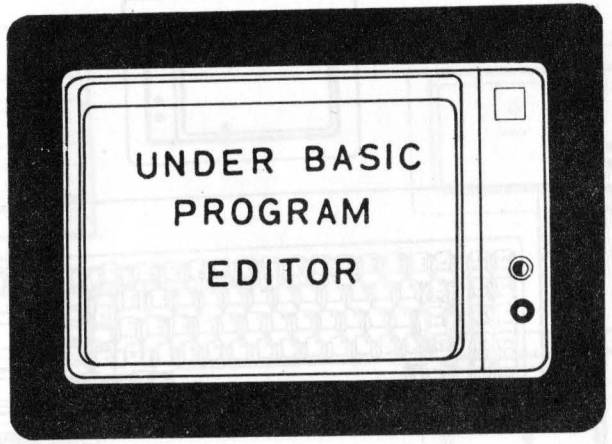
Ctrl-Num Lock

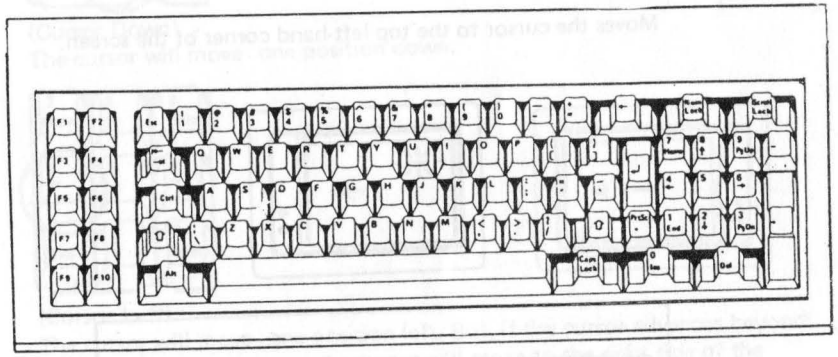
Pressing both Ctrl & Num Lock sends the computer into a pause state. This can be used to temporarily halt printing or program listing. The pause continues until the "shift" keys, the Break key, or the Ins key, is pressed.



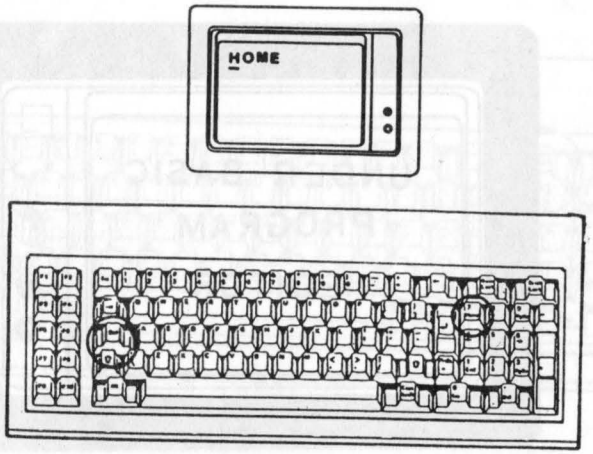
Alt-Ctrl-Del

When your computer power is on, Alt-Ctrl-Del performs a system Reset. In other words, it's similar to switching the computer from off to on. You must press the Ctrl and ALT keys in either order and hold them down, then press the Del key. Then you can release all those keys.Doing a system Reset with those keys it's preferable to flipping the power off and on again, because the system will start faster.



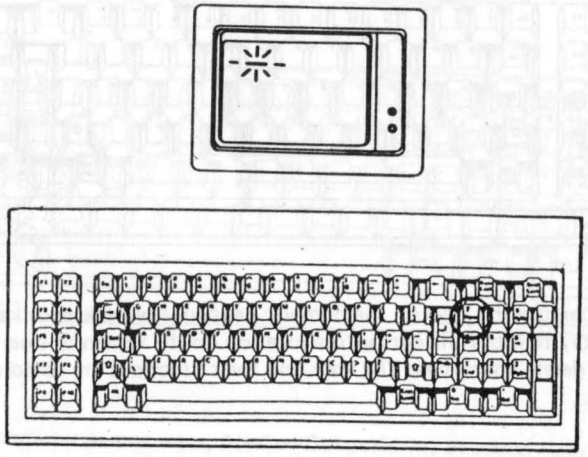


You can use the keys on the numeric keypad, the backspace key, and the Ctrl key to move the cursor to a location on the screen to insert characters, or to delete characters. The keys and their functions are listed on the next pages.



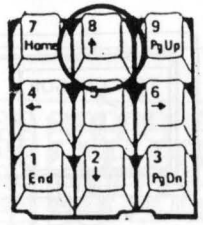
HOME

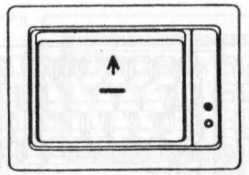
Moves the cursor to the top left-hand corner of the screen.



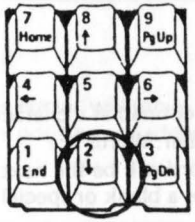
CTRL HOME

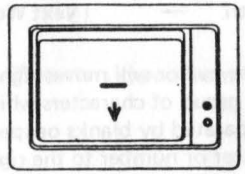
Clears the entire screen and positions, the cursor on Top left-hand corner of the screen.



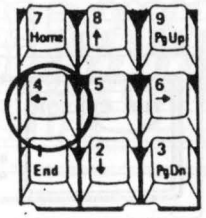


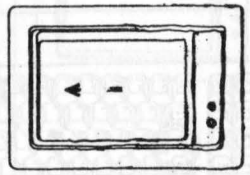
(Cursor Up)
The cursor will move one position up.



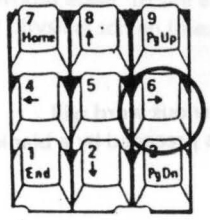


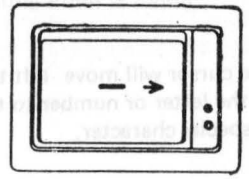
(Cursor Down)
The cursor will move one position down.



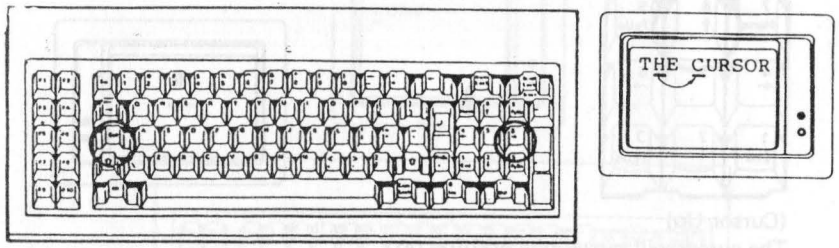


(Cursor Left)
The cursor will move one position left. But, if the cursor advances beyond the left edge of the screen, the cursor will move to the right side of the screen on the preceding line.



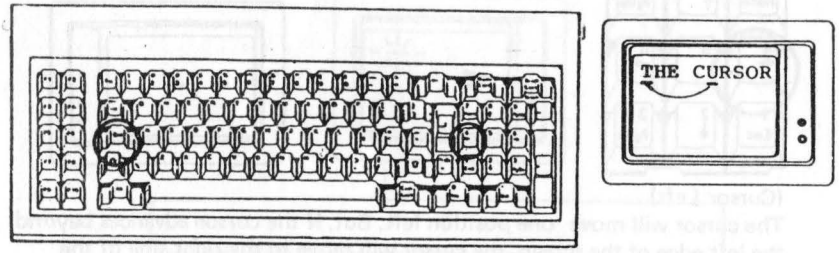


(Cursor Right)
The cursor will move one position right. But, if the cursor advances beyond the right edge of the screen, the cursor will move to the left side of the screen on the next poceced line .



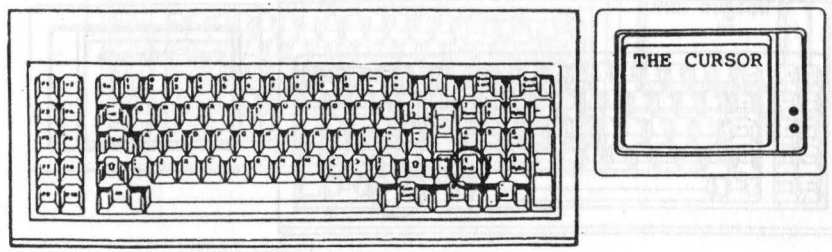
Ctrl → (Next Word)

The cursor will moves right to the next word. A word is defined as a character or group of characters which begins with a letter or number. Words are separated by blanks or special characters. So the next word will be the next letter or number to the right of the cursor which follows a blank or special character. For example, a comma (,) or period (.).



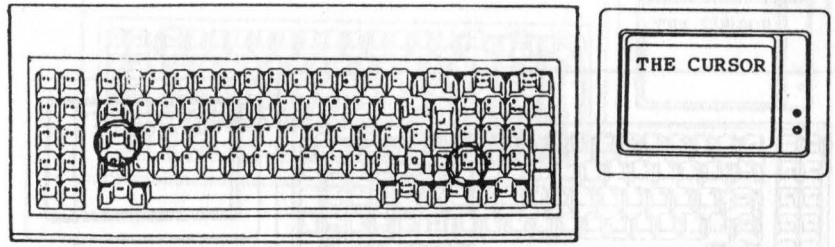
Ctrl ← (Previous Word)

The cursor will move left to the previous word. The previous word will be the letter or number to the left of the cursor which is preceded by a blank or special character.



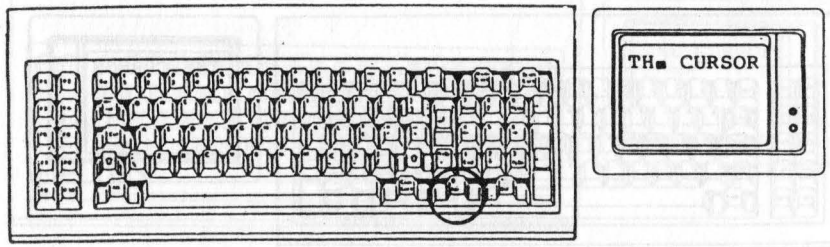
End

The cursor will move to the end of the logical line. Characters typed from this position are added to the end of the line.



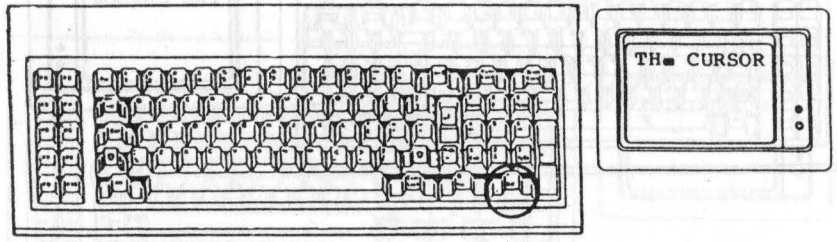
Ctrl-End

It would erase to the end of the logical line from the current cursor position. All physical screen lines are erased until the terminating Enter is found.



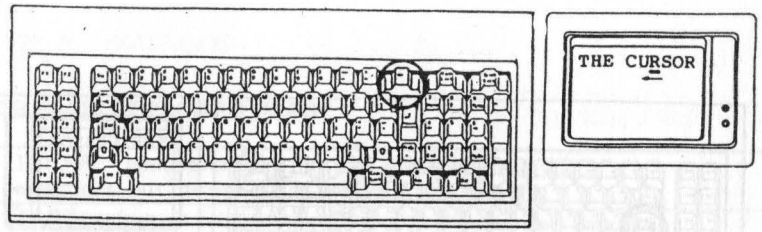
Ins

Set insert mode. If insert mode is off, then by pressing this key will turn it on. If insert mode is already on, then you will turn it off, when you press this key. When you are in insert mode, the cursor covers the lower half of the character position.



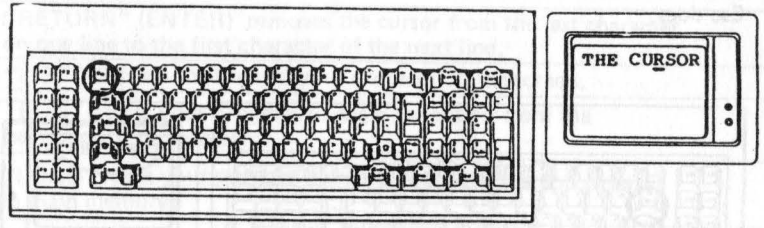
Del

The current cursor deletes the character position. All characters to the right of the deleted character move on position left to fill in the empty space.



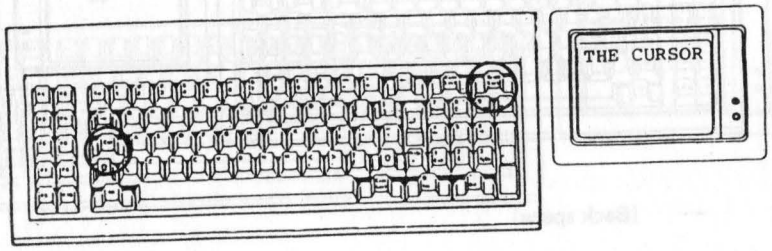
← (Back space)

Delete the last character typed. That is, it deletes the character to the left of the cursor. All the characters move to the right of the deleted character that left one position to fill in the space.



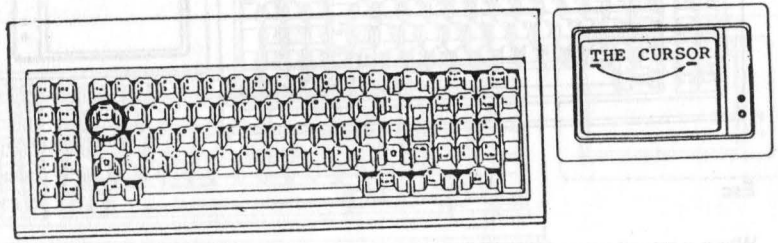
Esc

When pressed any where in the line, it would erase the entire logical line from the screen.



Ctrl-Break

Returns to command level, without saving any charges, that were made to the current line being edited. It does not erase the line from the screen like Esc does.



(Tab)

The cursor moves to the next tab stop. Tab stops occur every eight characters positions; that is, at positions 1, 9, 17, 25, 33, etc.

UNDER BASIC KEYBOARD USAGE

ESC	"ESCAPE" removes the list line that the cursor is on for corrections, but the line is not deleted from memory.
⇤⇥	"TAB" performs a tab function similar to a typewriter. Tabs are set every 8 characters.
CTRL	"CONOTROL" key is always used with another key to perform a command or function
⇧	"SHIFT" changes lower case letters to capitals.
ALT	"ALTERNATE" is used with alpha typing keys to eneter BASIC key words.
←	"BACK SPACE" key removes cursor to the left and removes one character for each key stroke.
↵	"RETURN" (ENTER) removes the cursor from the last character on one line to the first character of the next line.
F1	"LIST" displays the lines of your program on the screen.
F2	"RUN" causes your program to begin execution from the beginning of the program.
F3	"LOAD" reads your program from auxiliary storage and stores it in main memory.
F4	"SAVE" stores your program on auxiliary storage.
F5	"CONT" restarts your program after you have interrupted it by a STOP or CTRL BREAK.
F6	"LPTI:" refers to line printer and transfers data from screen to printer.
F7	"TRON" means trace on and causes the line numbers of program lines to be displayed as the lines are executed.
F8	"TROFF" means trace off and cancels command TRON.
F9	"KEY" is used to change the function of other function keys.
F10	"SCREEN" returns program to character mode from graphics mode and turns off color.

NUM LOCK ACTIVATE

1 thru 9	With "NUM LOCK" activated ONE through NINE will be operative.
DEL	"DECIMAL POINT" is used with numeric keypad.
0 INS	"ZERO" is used with numeric keypad.
–	"MINUS" is used with the numeric keypad.
+	"PLUS" is used with the numeric keypad.

NUM LOCK ACTIVATELESS

7 HOME	"HOME" removes the cursor the first character of the top line of the screen.
8 ↑	Moves the cursor one line up for each key stroke.
2 ↓	Moves the cursor down one line for each key stroke.
4 ←	Moves the cursor to the right one character for each key stroke.
6 →	Moves the cursor to the left one character for each eky stroke.
1 END	"END" moves the cursor to the last character on that line.
DEL	"DELETE" the character where the cursor is positioned.
0 INS	"INSERT" sets the keyboard to insert mode so that keys will be entered at the position of the cursor and all data to the right will move to the right. Pressing "INSERT" key again to exit insert mode.
CAPS LOCK	This is a toggle key: pressing the key will cause letters to type in upper case, pressing the key again will return lower case.
Prt Sc *	"PRINT SCREEN" will print an *. When pressed with the "SHIFT" key it will print all data on screen.
SCR LOCK	"SCROLL LOCK" is an inactive key.
* CTRL + SCROLL LOCK/BREAK = BREAK * CTRL + NUM LOCK = PAUSE * CTRL + →| = TAB * CTRL + |← = REVERSE TAB * CTRL + HOME = CLEAR SCREEN * CTRL + ALT + DEL = SYSTEM RESET	

UNDER DOS KEYBOARD USAGE

F1	Redisplays previously entered line, a character at a time.
F2	Enter F2 followed by a character. Screen will redisplay all of the previously entered line up to the character you entered.
F3	Redisplays entire previously entered line.
F4	Enter F4 followed by a character. Screen will skip all of the characters in the previously entered line up to the character you entered.
F5	Saves the currently displayed line for further editing.
* CTRL + NUM LOCK	= SUSPEND
* CTRL + PRT SC	= ECHO
* CTRL + SCR LOCK/BREAK	= BREAK

CHARACTER CODES

Key Number	Base Case	Upper Case	Ctrl	Alt
1	ESC	ESC	ESC	– #
2	1	!	– #	Note 1
3	2	@	Nul (000) Note 1	Note 1
4	3	#	– #	Note 1
5	4	$	– #	Note 1
6	5	%	– #	Note 1
7	6	^	RS (030)	Note 1
8	7	&	– #	Note 1
9	8	*	– #	Note 1
10	9	(	– #	Note 1
11	0	)	– #	Note 1
12	–	–	US (031)	Note 1
13	=	+	– #	Note 1
14	Back space (008)	Back space (008)	Del (127)	– #
15	→| (009)	|← (Note 1)	– #	– #
16	q	Q	DC 1 (017)	Note 1
17	w	W	ETB (023)	Note 1
18	e	E	ENQ (005)	Note 1
19	r	R	DC 2 (018)	Note 1
20	t	T	DC 4 (020)	Note 1
21	y	Y	EM (025)	Note 1
22	u	U	NAK (021)	Note 1
23	i	I	HT (009)	Note 1
24	o	O	S 1 (015)	Note 1
25	p	P	DLE (016)	Note 1
26	[	{	Esc (027)	– #

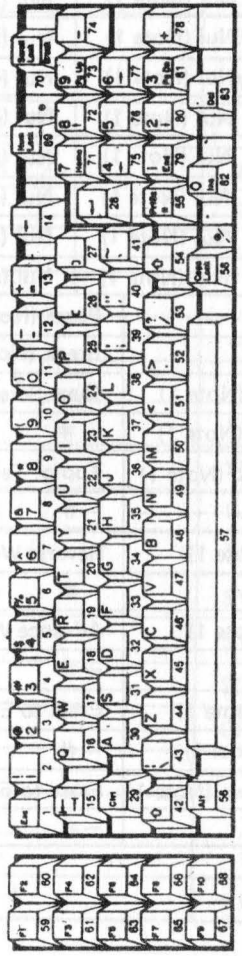
27	]	}	GS (029)	– #
28	CR	CR	LF (010)	– #
29	– #	– #	– #	– #
30	a	A	SOH (001)	Note 1
31	s	S	DC 3 (019)	Note 1
32	d	D	EOT (004)	Note 1
33	f	F	ACK (006)	Note 1
34	g	G	BEL (007)	Note 1
35	h	H	BS (008)	Note 1
36	j	J	LF (010)	Note 1
37	k	K	VT (011)	Note 1
38	l	L	FF (012)	Note 1
39	;	:	– #	– #
40	'	"	– #	– #
41	`	~	– #	– #
42	—#	– #	– #	– #
43	\	|	FS (028)	– #
44	z	Z	SUB (026)	Note 1
45	x	X	CAN (024)	Note 1
46	c	C	ETX (003)	Note 1
47	v	V	SYN (022)	Note 1
48	b	B	STX (002)	Note 1
49	n	N	SO (014)	Note 1
50	m	M	CR (013)	Note 1
51	,	<	– #	– #
52		>	– #	– #
53	/	?	– #	– #
54	– #	– #	– #	– #

55	*	Note 2	Note 1	– #
56	– #	– #	– #	– #
57	SP	SP	SP	SP
58	– #	– #	– #	– #
59	Nul (Note 1)	Nul (Note 1)	Nul (Note 1)	Nul (Note 1)
60	Nul (Note 1)	Nul (Note 1)	Nul (Note 1)	Nul (Note 1)
61	Nul (Note 1)	Nul (Note 1)	Nul (Note 1)	Nul (Note 1)
62	Nul (Note 1)	Nul (Note 1)	Nul (Note 1)	Nul (Note 1)
63	Nul (Note 1)	Nul (Note 1)	Nul (Note 1)	Nul (Note 1)
64	Nul (Note 1)	Nul (Note 1)	Nul (Note 1)	Nul (Note 1)
65	Nul (Note 1)	Nul (Note 1)	Nul (Note 1)	Nul (Note 1)
66	Nul (Note 1)	Nul (Note 1)	Nul (Note 1)	Nul (Note 1)
67	Nul (Note 1)	Nul (Note 1)	Nul (Note 1)	Nul (Note 1)
68	Nul (Note 1)	Nul (Note 1)	Nul (Note 1)	Nul (Note 1)
69	– #	– #	Pause (Note 2)	– #
70	– #	– #	Break (Note 2)	– #
71	7	Home (Note 1)	Clear Screen	– #
72	8	(Note 1)	– #	– #
73	9	Page Up (Note 1)	Top of Text & Home	– #
74	–	----------	– #	– #
75	4	(Note 1)	Reverse Word (Note 1)	– #
76	5		– #	– #
77	6	(Note 1)	Advance Word (Note 1)	– #
78	+	+	– #	– #
79	1	End (Note 1)	Erase to EOL (Note 1)	– #
80	2	(Note 1)	– #	– #
81	3	Page Down (Note 1)	Erase to EOS (Note 1)	– #
82	0	Ins	– #	– #

83		Del (Notes 1, 2)	Note 2	Note 2

A" – #" means the combination is suppressed in the keyboard routine.

Notes: 1. Refer to "Extended codes" in this section.
2. Refer to "Special Handing" in this section.



KEYBOARD EXTENDED FUNCTIONS

Second Code	Function
3	Nul Character
15	
16-25	Alt Q, W, E, R, T, Y, U, I, O, P
30-38	Alt A, S, D, F, G, H, J, K, L
44-50	Alt Z, X, C, V, B, N, M
59-68	F1 to F10 Function Keys Base Case
71	Home
72	↑
73	Page Down and Home Cursor
75	←
77	→
79	End
80	↓
81	Page Down and Home Cursor
82	Ins (Insert)
83	Del (Delete)
84-93	F11 to F20 (Uppercase F1 to F10)
94-103	F21 to F30 (Ctrl F1 to F10)
104-113	F31 to F40 (Alt F1 to F10)
114	Ctrl PrtSc (Start/Stop Echo to Printer)
115	Ctrl (Reverse Word)
116	Ctrl (Advance Word)
117	Ctrl End [Erase to End of Line (EOL)]
118	Ctrl PgDn [Erase to End of Screen (EOS)]
119	Ctrl Home (Clear Screen and Home)
120-131	Alt 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, –, = (Keys 2-13)
132	Ctrl PgUp (Top 25 Lines of Text and Home Cursor)

CHARACTERS OF KEYSTROKES

MSB / LSB	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	Ctrl @	Ctrl P	SP	0	@	P	`	p	Alt 128	Alt 144	Alt 160	Alt 176	Alt 192	Alt 208	Alt 224	Alt 240
1	Ctrl A	Ctrl Q	!	1	A	Q	a	q	Alt 129	Alt 145	Alt 161	Alt 177	Alt 193	Alt 209	Alt 225	Alt 241
2	Ctrl B	Ctrl R	"	2	B	R	b	r	Alt 130	Alt 146	Alt 162	Alt 178	Alt 194	Alt 210	Alt 226	Alt 242
3	Ctrl C	Ctrl S	#	3	C	S	c	s	Alt 131	Alt 147	Alt 163	Alt 179	Alt 195	Alt 211	Alt 227	Alt 243
4	Ctrl D	Ctrl T	$	4	D	T	d	t	Alt 132	Alt 148	Alt 164	Alt 180	Alt 196	Alt 212	Alt 228	Alt 244
5	Ctrl E	Ctrl U	%	5	E	U	e	u	Alt 133	Alt 149	Alt 165	Alt 181	Alt 197	Alt 213	Alt 229	Alt 245
6	Ctrl F	Ctrl V	&	6	F	V	f	v	Alt 134	Alt 150	Alt 166	Alt 182	Alt 198	Alt 214	Alt 230	Alt 246
7	Ctrl G	Ctrl W	'	7	G	W	g	w	Alt 135	Alt 151	Alt 167	Alt 183	Alt 199	Alt 215	Alt 231	Alt 247
8	Ctrl H	Ctrl X	(	8	H	X	h	x	Alt 136	Alt 152	Alt 168	Alt 184	Alt 200	Alt 216	Alt 232	Alt 248
9	Ctrl I	Ctrl Y	)	9	I	Y	i	y	Alt 137	Alt 153	Alt 169	Alt 185	Alt 201	Alt 217	Alt 233	Alt 249
A	Ctrl J	Ctrl Z	*	:	J	Z	j	z	Alt 138	Alt 154	Alt 170	Alt 186	Alt 202	Alt 218	Alt 234	Alt 250
B	Ctrl K	Ctrl [	+	;	K	[	k	{	Alt 139	Alt 155	Alt 171	Alt 187	Alt 203	Alt 219	Alt 235	Alt 251
C	Ctrl L	Ctrl \	,	<	L	\	l	|	Alt 140	Alt 156	Alt 172	Alt 188	Alt 204	Alt 220	Alt 236	Alt 252
D	Ctrl M	Ctrl]	-	=	M	]	m	}	Alt 141	Alt 157	Alt 173	Alt 189	Alt 205	Alt 221	Alt 237	Alt 253
E	Ctrl N	Ctrl ^	.	>	N	^	n	~	Alt 142	Alt 158	Alt 174	Alt 190	Alt 206	Alt 222	Alt 238	Alt 254
F	Ctrl O	Ctrl _	/	?	O	_	o	Ctrl ←	Alt 143	Alt 159	Alt 175	Alt 191	Alt 207	Alt 223	Alt 239	Alt 255

Alt xxx — The 3 difits after the Alt key must be typed from the numeric key pad character code 000 through 255 can be entered in this fashion.

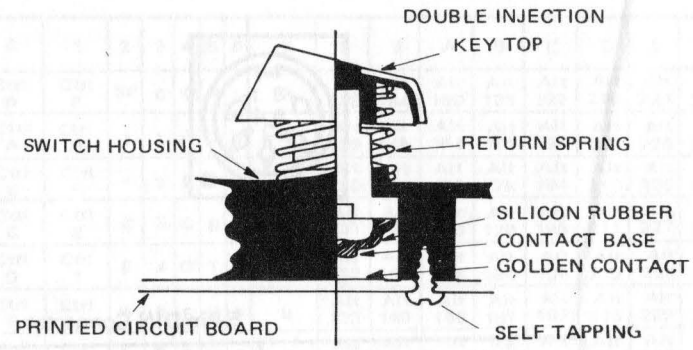
. (With Caps Lock activated, character codes 97 through 122 will display upper case rather than lower case alphabetic character)

KEYBOARD CONECTOR

5-Pin DIN Connector

Pin	TTL Signal	Signal Level
1	Keyboard Clock	+5 Vdc
2	Keyboard Data	+5 Vdc
3	Keyboard Reset (Not used by Keyboard)	
4	Gound	0
5	+5 Volts	+5 Vdc

KEY SWITCH INFORMATION



SPECIFICATIONS:

Total Travel:	.148" (3.8 mm)
Pretravel:	.74 (1.9 mm)
Operating Force:	Normal 60g
Operating Life:	Ten-million operating or more
Contact Resistor:	500 Ohm or less
Bounces:	5 msec or less

6 COLOR GRAPHIC CARD

I. FEATURES

1. Attachable to the color monitor, television-frequency monitor, or home television sets (user-supplied RF modulator is required for home television sets).
2. Capable of operating in black-and-white or color mode. In the color mode, up to sixteen for foreground and eight background colors are available, in black-and-white mode, the character attributes of reverse video, blinking, and highlighting are available.
3. Two Operating Mode:
   Alphanumeric Mode:
   40 column x 25 rows for low-resolution monitor or home television.
   80 column x 25 rows for high-resolution monitor.
   Graphics Mode:
   320 dots x 200 rows for high-resolution monitor.
   640 dots x 200 rows for high-resolution black-and-white graphics mode.
4. Implementing a Motorola 6845 CRT controller, and contains 16K bytes of storage.
5. Three video interfaces:
   A composite-video port, a direct drive port, and a connection interface for driving a usersupplied RF modulator.
6. A light pen interface is provided.

II. COLOR GRAPHICS ADAPTOR PROGRAMMING REFERENCE

This section provides information required for programming the color graphics adaptor.
It can be used in conjunction with the I/O port map for this board.

1. Initialization
   Reset the video enable bit of the mode register (Port 3D8, Bit 3). Next, program the CRT controller chip (Ports 3D4 and 3D5) for the desired operation. Finally, program the mode and color registers (Ports 3D8 and 3D9).

2. Mode Register Programing

Video Mode	Mode Byte
40 x 25 Alpha B & W	2CH
40 x 25 Alpha Color	28H
80 x 25 Alpha B & W	2DH
80 x 25 Alpha Color	29H

320 x 200 Graphics B & W	0EH
320 x 200 Graphics Color	0AH
320 x 200 Graphics B & W	1EH

Note: To control high intensity of background using the blinking attributed in alpha modes, clear Bit 5 of the mode byte. Since Bit 3 of all mode bytes is set, the video will be enabled when the mode is programmed.

3. Color Register Programming

Bit 0 — Selects blue as a border in 40 x 25 alpha mode or as a background color in 320 x 200 color graphics mode.

Bit 1 — Selects green as a border color in 40 x 25 alpha mode or as a background color in 320 x 200 graphics mode.

Bit 2 — Selects red as a border color in 40 x 25 alpha mode or as a background color in 320 x 200 color graphics mode.

Bit 3 — Intensifies the border color in 40 x 25 alpha mode or background color in 320 x 200 color graphics mode.

The above bits define the following colors:

0000 = Black	0110 = Brown	1100 = Lt Red
0001 = Blue	0111 = Lt Gray	1101 = Lt Magenta
0010 = Green	1000 = Dk Gray	1110 = Yellow
0011 = Cyan	1001 = Lt Blue	1111 = White
0100 = Red	1010 = Lt Green	
0101 = Magenta	1011 = Lt Cyan	

Bit 4 — Intensifies the background colors in the alpha mode.

Bit 5 — Selects the pallette for 320 x 200 color Graphics mode. The pallette defines the color produced by each value of the pixel (C1, C0) for that point of the screen.

If Bit 5 = 1			If Bit 5 = 0		
C1	C0	Color	C1	C0	Color
0	0	Background Color	0	0	Background color
0	1	Cyan	0	1	Green
1	0	Magenta	1	0	Red
1	1	White	1	1	Brown

4. Status Register Interpretation

The status register (Port 3DA) of the color graphics video board is used for video buffer access timing and light pen testing.

Bit 0 — This bit is high when the video disply is blanked during a sync interval. In 80 x 25 alpha mode, the video buffer should not be accessed by the CPU unless this bit is high or the access will produce interference in the form of a short horizontal line on the display.

Bit 1 — Indicates that a rising edge from the light pen switch has set the light pen trigger. This status may be cleared or set by out-putting any data byte to ports 3DB or 3BC respectively.

Bit 2 — If 0, indicates the light pen switch is on. Switch is not debounded or latched.

Bit 3 — This signal is high during the vertical sync interval of the display.

5. Video Buffer Organization

The video buffer consists of 16K bytes of RAM located at B8000-BBFFF. The format of data in the memory is different from each type of display mode.

80 x 25 Alpha Modes

Display-character code Byte								Attribute Byte							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0

Each character position is defined by two consecutive bytes in the video buffer. The first byte is the ASCII character code, and the second byte is the attribute. The screen holds 2000 characters which requires 4,000 bytes. Consecutive locations in the buffer located at the upper left corner of the screen. The 256 character patterns are generated by a 2K byte ROM on the Color/Graphics Adaptor. It defines the character as a 7 x 7 pattern in an 8 x 8 box. The attribute byte is defined as follows:

Bit 0 — Blue Character
Bit 1 — Green Character
Bit 2 — Red Character
Bit 3 — Intensify Character
Bit 4 — Blue Background
Bit 5 — Green Background
Bit 6 — Red Background
Bit 7 — Blinking Character

Bit 7 Can be redefined to intensify background by setting Bit 5 of the mode register.

For black and white modes, select black by turning all colors off and white by turning all colors on.

40 x 25 Alpha Modes

These modes are similar to the 80 x 25 alpha modes except that the screen only holds 1,000 characters and therefore required 2,000 bytes.

320 x 200 Graphics

This mode uses 16,000 bytes of memory, organized a 4 pixels horizontally per byte. The screen is divided into two buffers, the first holding data for the even scan lines (0, 2, 4 . . . . 198) at addresses B8000-B9F3F and the second holding data for the odd scan lines (1, 3, 5, ... 199) at addresses BA000-BBF3F. Each pixel is defined by 2 bits, with the top left corner of the screen being B7 and B6 of the first byte. Each line consists of 320 pixels, which is defined by 80 consecutive bytes in the buffer. The color of the displayed pixel is selected from the current pallette by the value of the bits (C1, C0, where C1 is the higher order bit). See the description of Bit 5 in the color register programming for a definition of the pallettes. The black and white mode is similar to color, except that the color burst is disabled.

640 x 200 Black and White Graphics
This mode is similar to 320 x 200 color graphics mode except that each bit represents 1 pixel on the screen and there are twice as many pixels per line. Therefore, a line is represented by 80 consecutive bytes in the buffer as in 320 x 200 mode. Black is encoded as zero and white as one. The upper left corner of the screen is B7 of the first byte of the buffer.

6. Character Generation in Graphics Modes
A table of the first 128 characters similar to the alpha mode character generator is in the ROM. Each character is defined by 8 consecutive bytes, representing the LIT pixels for each row of the character from top to bottom. The most significant bit represents the left-hand dot of a row. When the data is transfered to the video memory to be displayed, it must be split into even and odd row data and written to the appropriate buffers, any other characters which are to be displayed (including those corresponding to Codes 128-255 in alpha mode) must be defined by the user. These patterns will be accessed as codes 128-255 by the ROM's INT 10H graphics character routines if the user points to the table with interrupt vector 1FH.

7. Standard Initialization for 6845 CRT Controller Circuit
The CRT controller is intialized for a given display mode by outputting a string of 16 bytes to its register 0 – 15 respectively. For each byte to be output, the register number must first be output to the address register (port 3D4), followed by the data byte to the desired register (port 3D5).

The strings used by the ROM for the 40 x 25 alpha, 80 x 25 alpha and graphics modes are given in the description of INT 10H.

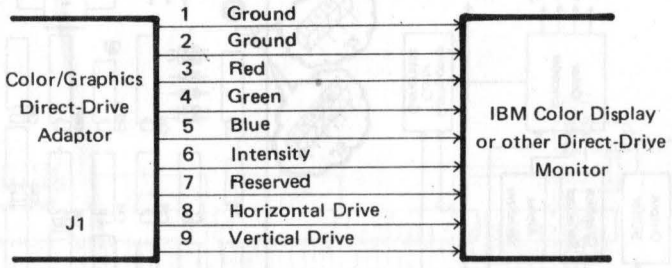
I/O MAP, COLOR GRAPHICS ADAPTOR

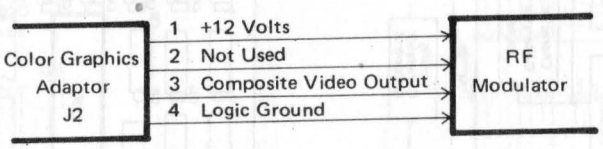
prot (Hex)	Type	Function	Bit Definitions
Motorola 6845 CRT Controller Circuit:			
3D4	Output	Address Register	
3D5	I/O	18 Registers	
Miscellaneous Ports:			
3D8	Output	Mode Register	B0 = 80 x 25 Mode B1 = 320 x 200 Graphics B2 = B & W Mode B3 = Enable Video B4 = 640 x 200 B & W B5 = Blinking B6 = Not Used B7 = Not Used
3D9	Output	Color Register	B0 = Blue B1 = Green B2 = Red B3 = Intensify R.G.B. B4 = Alt. Back Colors B5 = 320 x 200 Color Set B6 = Not Used B7 = Not Used
3DA	Input	Status Register	B0 = Video Sync B1 = Light Pen Trig'd B2 = Pen Switch off B3 = Alpha Data B4 = Not Used B5 = Not Used B6 = Not Used B7 = Not Used
3DB	Output	Clear Light Pen Latch	
3DC	Output	Set Light Pen Latch	

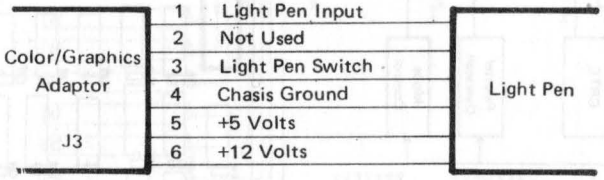
Memory Map of Color Graphics Adaptor:

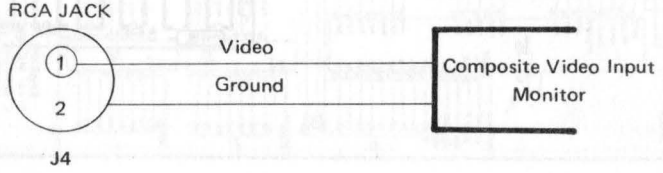
Address Range (Hex)	Memory Type	Function
B8000-BBFFF	RAM	Video Display Buffer

Connector Specifications

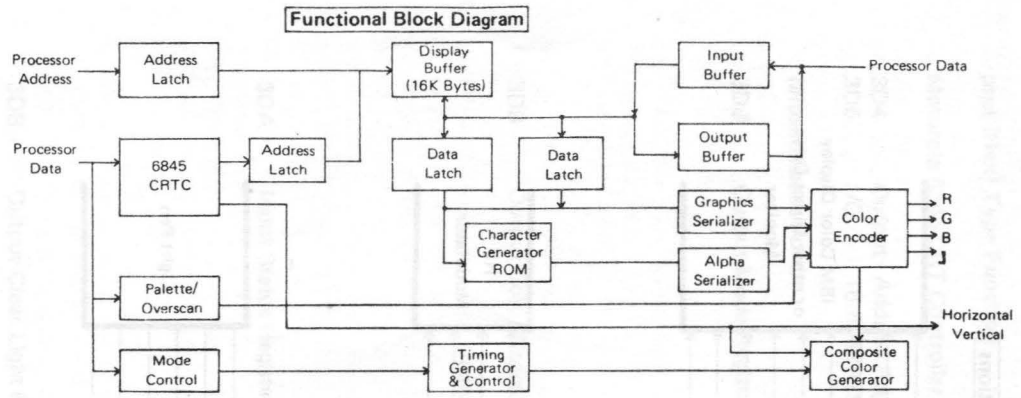


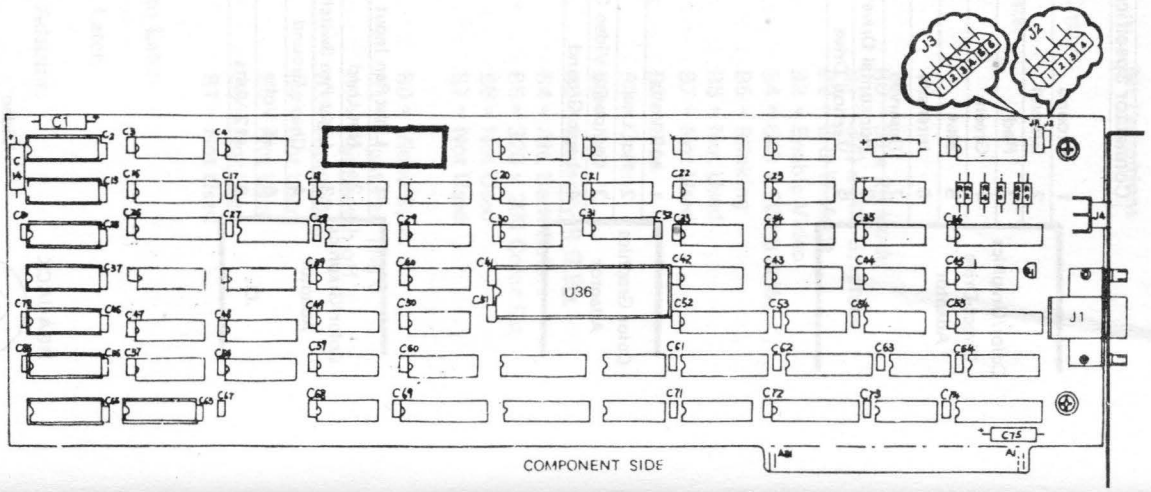


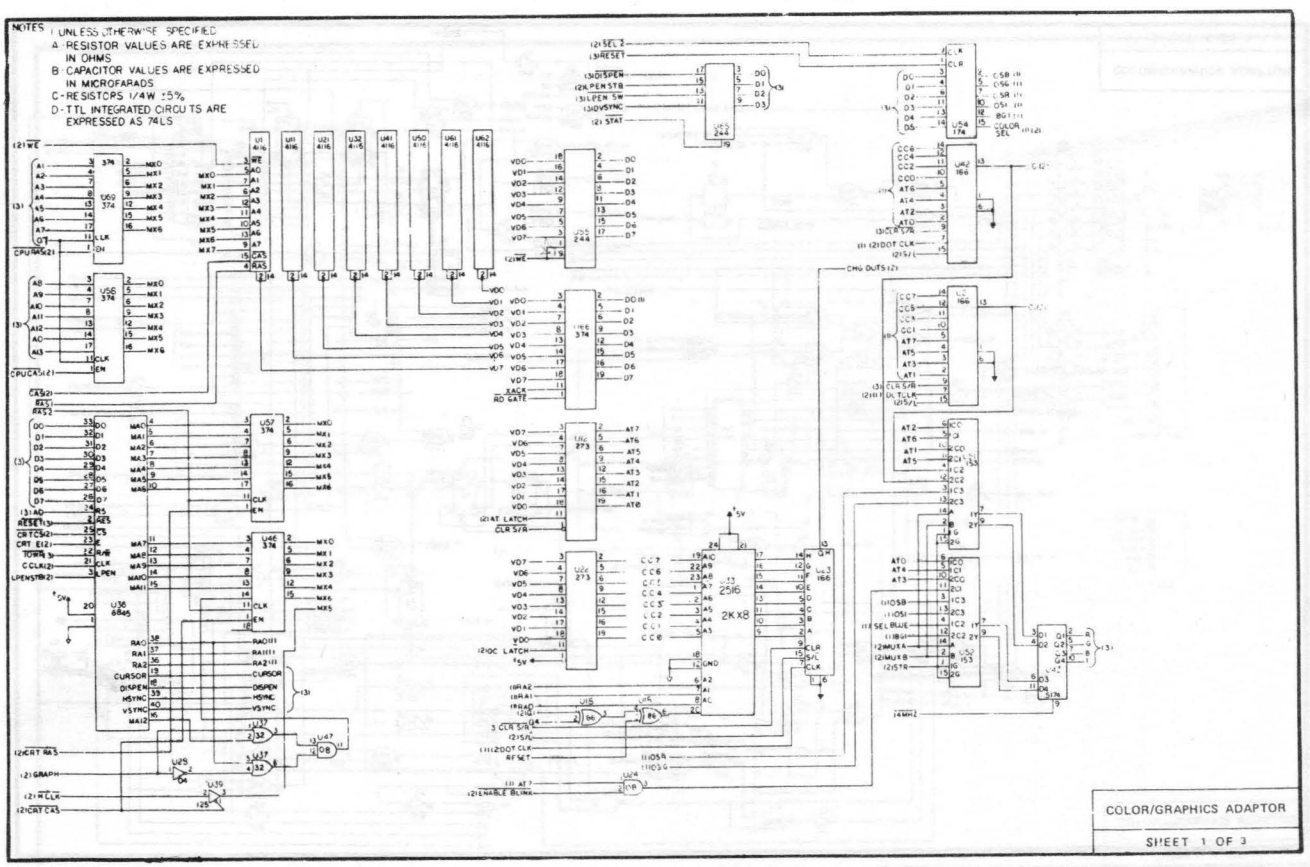


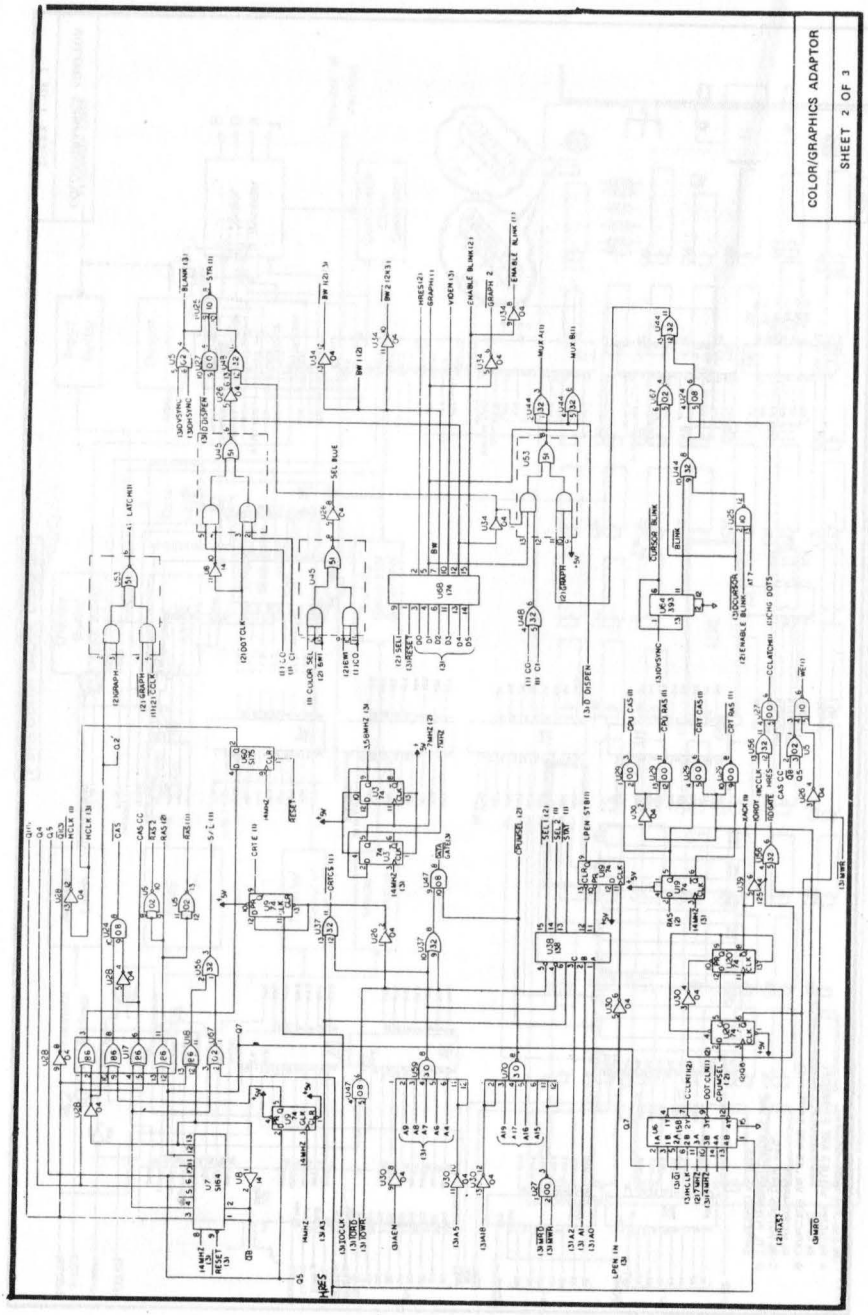


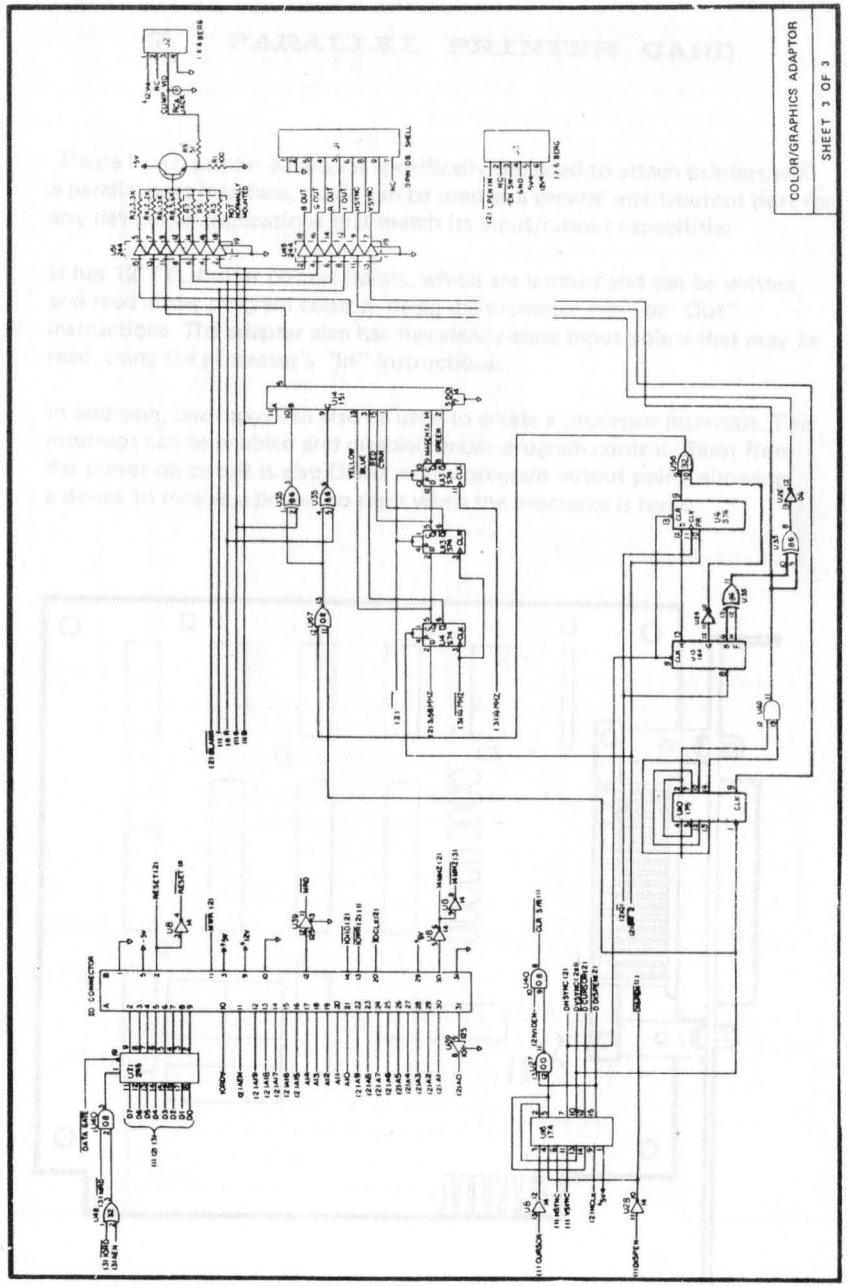
Functional Block Diagram






NOTES
1. UNLESS OTHERWISE SPECIFIED
A - RESISTOR VALUES ARE EXPRESSED IN OHMS
B - CAPACITOR VALUES ARE EXPRESSED IN MICROFARADS
C - RESISTORS 1/4W ±5%
D - TTL INTEGRATED CIRCUITS ARE EXPRESSED AS 74LS
COLOR/GRAPHICS ADAPTOR
SHEET 1 OF 3


COLOR/GRAPHICS ADAPTOR
SHEET 2 OF 3

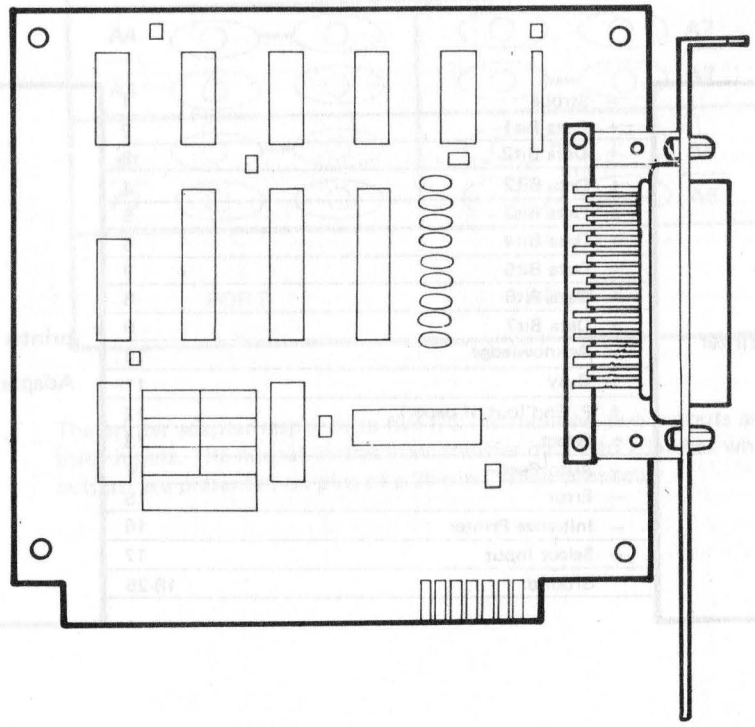

COLOR/GRAPHICS ADAPTOR
SHEET 3 OF 3

7 PARALLEL PRINTER CARD

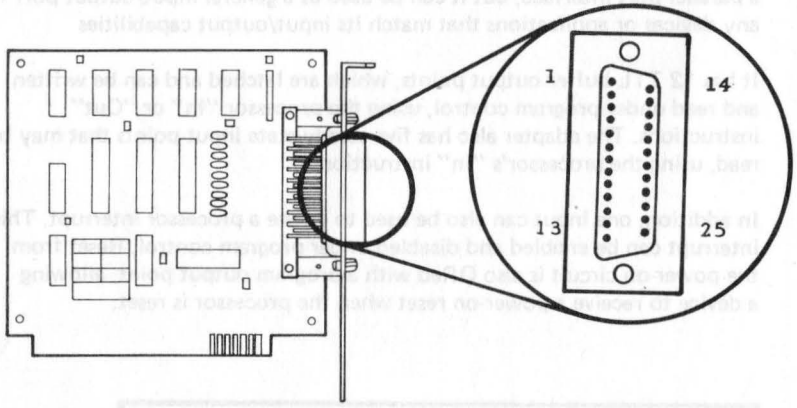
Parallel printer adapter is specifically designed to attach printers with a parallel port interface, but it can be used as a general input/output port for any devices or applications that match its input/output capabilities

It has 12 TTL-buffer output points, which are latched and can be written and read under program control, using the processor "In" or "Out" instructions. The adapter also has five steady-state input points that may be read, using the processor's "In" instructions.

In addition, one input can also be used to create a processor interrupt. This interrupt can be enabled and disabled under program control. Reset from the power-on circuit is also ORed with a program output point, allowing a device to receive a power-on reset when the processor is reset.



The input/output signals are available at the back of the adapter through a right-anyled, PCB-mounted. 25-pin, D-shell connector.
This connector protrudes through the rear panel of the system or expansion unit, where a cable may be attached.



printer	– Strobe	1
	+ Data Bit1	2
	+ Data Bit2	3
	+ Data Bit2	4
	+ Data Bit3	5
	+ Data Bit4	6
	+ Data Bit5	7
	+ Data Bit6	8
	+ Data Bit7	9
	– Acknowledge	10
	+ Busy	11
	+ P. End (out of paper)	12
	+ Select	13
	– Auto Feed	14
	– Error	15
	– Initialize Printer	16
	– Select Input	17
	Ground	18-25

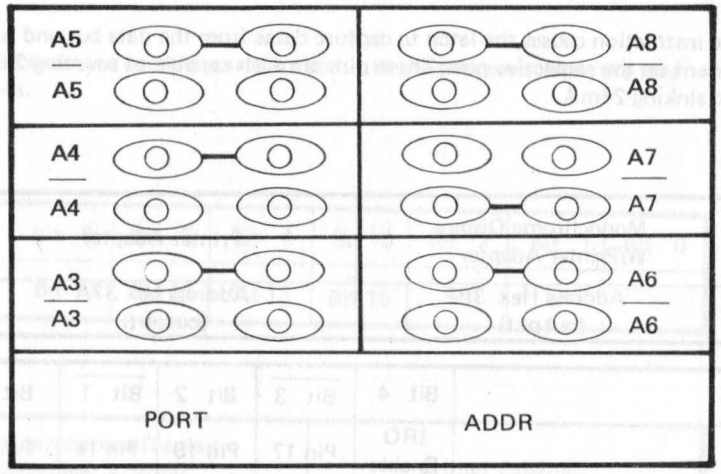
printer Adapter

When this adapter is used to attach a printer, data or printer commands are loaded into an 8-bit, latched, output port, and the strobe line is activated. writing data to the printer. The program then may read the input ports for printer status indicating when the next character can be written, or it may use the interrupt line to indicate "not busy" to the software.

Parallel printer adapter can be adjust the port address by changing the jumper near the lefe down corner there is a block "PORT ADDR", Jumpers can be select the correct address.

When the printer adapter is shipped from the factory, the switches are set as follows:

Factory setting: hex 378



The printer adapter responds to five I/O instructions, two outputs and three inputs. The output instructions transfer data into 2 latches whose outputs are presented on pins of a 25-pin D-shell connector.

Two of the three input instructions allow the processor to read back the contents of the two latches. The third allows the processor to read the real time status of a group of pins on the connector.

Monochrome Display W/Printer Adapter	Printer Adapter
Address hex 3BC (output)	Address hex 378 (output)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Pin 9	Pin 8	Pin 7	Pin 6	Pin 5	Pin 4	Pin 3	Pin 2

The instruction causes the latch to capture datas from the data bus and is present on the respective pins. These pins are each capable of sourcing 2.6mA and sinking 24mA.

Monochrome Dispay W/Printer Adapter	Printer Adapter
Address Hex 3BE (output)	Address hex 37A (output)

	Bit 4	$\overline{\text{Bit 3}}$	Bit 2	$\overline{\text{Bit 1}}$	Bit 0
	IRQ Enable	Pin 17	Pin 16	Pin 14	Pin 1

This instruction causes the latch to capture the five least significant bits of the data bus. The four least significant bits present their outputs or inverted versions of their outputs, to the respective pins shown above. If bit 4 is written as 1, the card will interrupt the processor on the condition that pin 10 Transitions high to low.

These pins are driven by open collector drives pulled to +5 Vdc through 4.7K-ohm resistor array. They can each sink approximately 7mA and maintain 0.8 volts down-level.

This command presents the processor which data present on the pins associated with the out to hex 3BC. This should normally reflect the exact value that was last written to hex 3BC. If an external device should be driving data on these pins (in violation of usage grand rules) at the time of an input, this data will be ORed with the latch contents.

Monochrome Display W/Printer Adapter	Printer Adapter
Address hex 3BD (Input)	Address hex 379 (Input)

And this command presents realtime status to the processor from the pins as follows.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Bit 11	Bit 10	Bit 12	Bit 13	Bit 15	—	—	—

Monochrome Display W/Prineer Adapter	Printer Adapter
Address hex 3BE (Input)	Adress hex 3FA (Input)

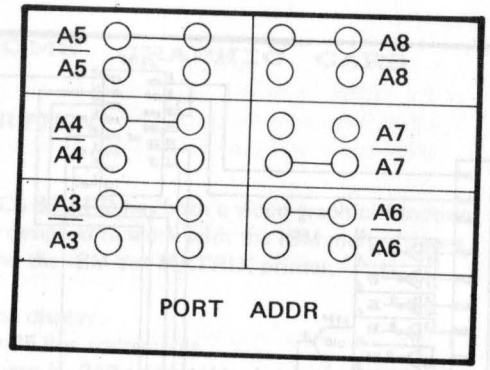
This instruction causes the data present on pins 1, 14, 16, 17, and the IRQ bit to be read by the processor. In the absence of external drive applied to these pins, data read by the processor will exactlly match data last written to hex 3BE in the same bit positions. Note that data bits 0-2 are not included. If external drivesrs are dotted to these pins, that data will be ORed with data applied to the pins by the hex 3BE latch.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
			IRQ Enable	$\overline{\text{Pin 17}}$	Pin 16	$\overline{\text{Pin 14}}$	$\overline{\text{Pin 1}}$
			Por=0	Por=1	Por=0	Por=1	Por=1

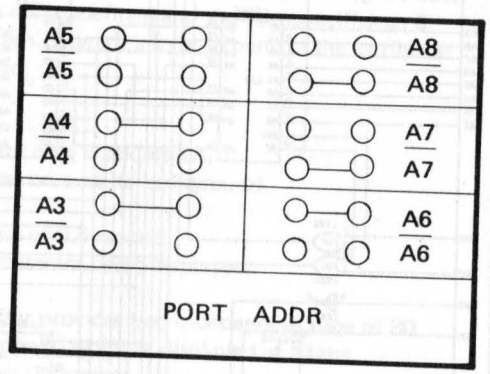
Adjust the port address

		JUMPER								
Address \ Bit	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0
278	1	0	0	1	1	1	1	0	0	0
378	1	1	0	1	1	1	1	0	0	0
3BC	1	1	1	0	1	1	1	1	0	0

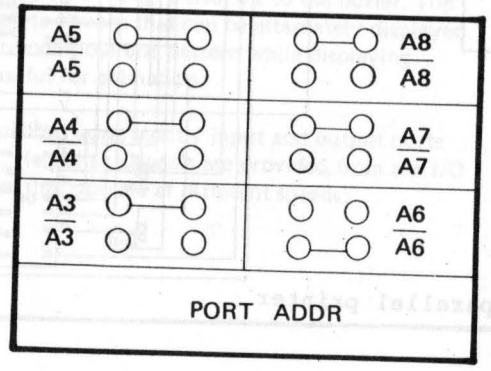
Address: 378

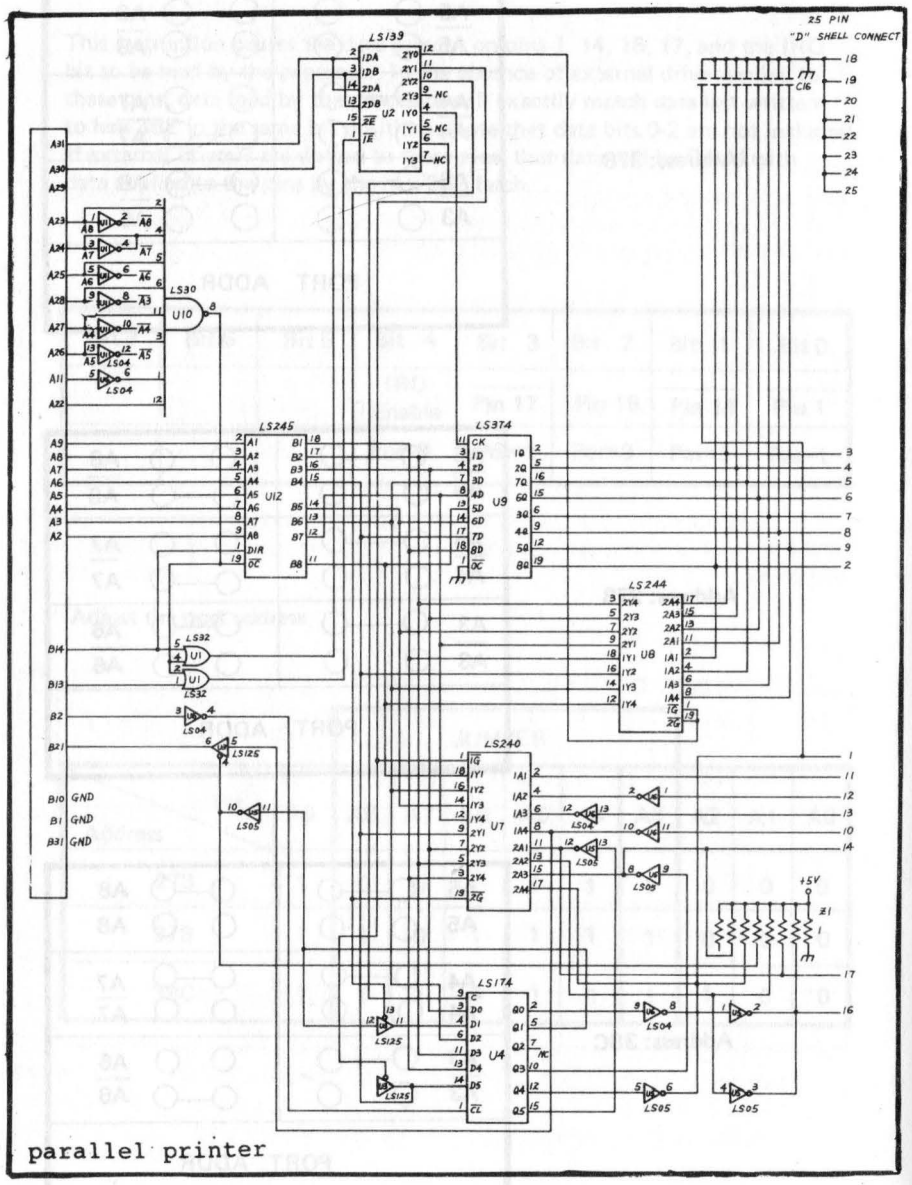


Address: 278



Address: 3BC





parallel printer

8 MONOCHROME GRAPHIC CARD

SECTION I: GENERAL DESCRIPTION

The MONOCHROME GRAPHICS BOARD has both a video graphics function and a printing function that are designed to work with the IBM monochrome display (18.7 KHZ H. SYNC) and the IBM dot MATRIX printer.

This board has two modes for the display:
1. TEXT MODE: 80 column by 25 line addressable.
2. GRAPHICS MODE: 720 column by 348 addressable dots.

In TEXT mode, each type in the buffer controls a character of 9 by 14 dots. The pattern of these characters are predefined and the user specifies an 8 bit code to call them to the screen. There is a byte to control the attributes of each character being displayed.

The attributes can be:

NORMAL:	a white character on a black screen.
REVERSE:	a black character on a white background.
HIGHLIGHT:	brighter color.
BLINK:	blinking at a rate of 0.5 second.
UNDERLINE:	underline the character being displayed.

IN TEXT mode, the display buffer provides two independent page of 80 columns by 25 lines each, only one of which is displayed at a time.

In GRAPHICS mode, the bits in the buffer, control the actual dots on the screen. Screen patterns are formed by writing I's and '0's to the buffer. The buffer is organized as two complete screens that can be alternately displayed. This feature makes it possible to compose one pattern while displaying another, which is particularly useful for animation.

The printing function is implemented using strictly input and output ports with a parallel interface printer. Handshake signals are provided from the I/O ports to allow the use of printers that operate at different speeds.

The MONOCHROME GRAPHICS BOARD is directly compatible with the I.B.M. Monochrome card in TEXT mode and PRINTER port with an enhanced function of 720X 348 graphics on a monochrome monitor.

A SBASIC1/2 program is provided to update the BASICA program for graphics functions. Section III will describe the SBASIC1/2 in detail. Section II describes the Hardware Technical Information.

SECTION II: HARDWARE TECHNICAL INFORMATION

A) DISPLAY BUFFER

In TEXT mode, each 16 bit word represents one character with the character code in the even byte and the attribute code in the odd byte. Each line of text (80 characters) uses up to 160 consecutive bytes.

There are two text pages, with page 0 starting at &HB0000 to &HB0FFF and page 1 at &HB8000 to &HB8FFF. By writing a '0' to bit 7 of the display mode control port (&H3B8) will select page 0 for display and writing a '1' will select page 1.

The attribute is controlled by the attribute data byte as follows:

DATA BIT:	7	6	5	4	3	2	1	0	ATTRIBUTE
	B	0	0	0	I	0	0	0	BLANK
	B	0	0	0	I	0	0	1	UNDERLINE
	B	0	0	0	I	1	1	1	NORMAL VIDEO
	B	1	1	1	I	0	0	0	REVERSE VIDEO

WHERE: I = 0 for normal body intensity
= 1 for high body intensity
If BLINK ENABLE = 0
B = 0 for normal background intensity
= 1 for high background intensity
If BLINK ENABLE = 1
B = 0 for not blinking
= 1 for blinking

In graphics mode, each horizontal line of 720 dots is stored in the buffer as 90 consecutive bytes, with bit 7 as the leftmost bit on the screen. The buffer store two full screens by putting page 0 at B0000 to B7FFF and page 1 at B8000 to BFFFF. Each page is divided into 4 fields of 8K consecutive bytes. The display takes one line from field 0, and then goes to fields 1,2 and 3. This sequence continues for the entire screen so the adjacent lines from the same field are displayed 4 lines apart on the screen.

B) MEMORY MAP

DISPLAY BUFFER: &HB0000 – &HBFFFF

TEXT MODE:

Page 0 at B0000 to B0FFF
Page 1 at B8000 to B8FFF

GRAPHICS MODE:

Page 0 at B0000 to B7FFF
Page 1 at B8000 to BFFFF

ADDRESS CALCULATION

DEF. V = vertical column (0 to 719);
X = integer (V/8)
H = horizontal line (0 to 347);
Y - integer (H/4)

BYTE ADDRESS LINES

```
 F  E  D  C  B  A  9  8  7  6  5  4  3  2  1  0
!     !     !                                  !
PAGE (H mod 4)          (90 * Y) + X
 no.
```


C) I/O MAP

I/O PARTS:
3B4 6845 INDEX REGISTER
3B5 6845 DATA REGISTER
3B8 DISPLAY MODE CONTROL PORT
3BA DISPLAY STATUS PORT
3BC PRINTER DATA PORT
3BD PRINTER STATUS PORT
3BE PRINTER CONTROL PORT

1) 6845 REGISTER TABLE (3B5 WITH REGISTER #WRITTEN TO 3B4)

REG. #	VIDEO PARAMETER	TEXT VALUE	GRAPHICS VALUE	UNIT
R0	HORIZONTAL TOTAL	97	53	CHAR
R1	HORIZONTAL DISPLAY	80	45	CHAR
R2	HSYNC POSITION	82	46	CHAR
R3	HSYNC WIDTH	15	8	CHAR
R4	VERTICAL TOTAL	25	91	ROWS
R5	VERTICAL ADJUST	6	2	LINES
R6	VERTICAL DISPLAYED	25	87	CHAR
R7	VSYNC POSITION	25	87	ROWS
R8	INTERLACE MODE	2	2	ROWS
R9	MAX. SCAN LINE ADDR	13	3	----
R10	HORIZONTAL DISPLAY	12	0	LINES
R11	HORIZONTAL DISPLAY	0	0	LINES
R12	SCREEN START ADDR (H)	0	0	----
R13	SCREEN START ADDR (L)	0	0	----
R14	CURSOR ADDR (H)	0	0	----
R15	CURSOR ADDR (L)	0	0	----

NOTE: For more technical information about the 6845 CRT controller chip, please refer to the 6845 manual.

2) DISPLAY MODE CONTROL PORT

BIT 1: GRAPHIC ENABLE

When cleared, the video information comes from the character generator and the attribute decoding logic. The character codes are fetched from even bytes in the display buffer. The corresponding attribute codes are fetched from the next odd byte. When this bit is set, video information comes from bits in the display buffer itself.

BIT 3: VIDEO ENABLE
This bit gives the video information onto the screen.
BIT 5: BLINK ENABLE
This bit is used only when the graphics bit is cleared. It causes a character to blink if its attribute code has bit 7 set.
BIT 7: PAGE SELECT
This bit selects the display page in both text and graphics modes.

3) DISPLAY STATUS PORT
BIT 0: HORIZONTAL SYNC
This bit is set during the horizontal retrace period.
BIT 3: VIDEO OUTPUT
This bit echoes the video signal being sent to the screen.
BIT 7: –VERTICAL SYNC
This bit is cleared during the vertical retrace period.

4) PRINTER CONTROL PORT
BIT 0: STOBE–
A "O" in this bit cause the printer to read the data. The period must be 0.5 microseconds.
BIT 1: AUTOFEED+
Setting this bit cause the printer to line feed after printing.
BIT 2: INIT–
A "O" in this bit resets the printer.
BIT 3: SELECT+
Setting this bit selects the printer and enable subsequent data transfers.
BIT 4: IRQ7 ENALBE+
Setting this bit causes a level 7 interrup, to be generated even time the printer acknowledges a transfer of data.

5) PRINTER STATUS PORT
BIT 3: ERROR–
This bit is set if the printer shows no fault in operation.
BIT 4: SELECT STATUS+
This bit is set when the printer is in the selected state and ready to accept data.
BIT 5: PAPER OUT+
This bit is set when the printer is out of paper.
BIT 6: ACK–
This bit is cleared for about 5 microseconds when the printer is ready to accept another data transfer.
BIT 7: BUSY–
This bit is set when the printer is ready to accept data. It will be cleared during data entries, printing operation and error states. The printer will also clear this bit when it is off-line.

SECTION III: SOFTWARE TECHNICAL INFORMATION

A) HBASIC

The purpose of HBASIC , is to allow you to use BASICA's graphics system with the MONOCHROME GRAPHICS BOARD. The HBACIC1 is use with DOS 1.10 only and the HBASIC is use with DOS 2.00 only. We will refer both HBASIC1 and HBASIC as BASICA's

Before you use HBASIC , you must load the BASICA to the diskette first, we suggest that you protect your BASIC diskette and make a copy of it.

The HBASIC contains these files as follows:

HBASIC1.EXE: for DOS 1.10 only
HBASIC.EXE: for DOS 2.00 only
MGB-DEMO.BAS: a DEMO file for TEXT and GRAPHICS
MGB-INFO.DAT: a INFORMZTION file for your reference

To use the HBASIC , type

HBASIC1 (ENTER) (for DOS 1.10)
HBASIC (ENTER) (for DOS 2.00)

The HBASIC will call the BASICA automatically and modify it for the graphics statements. You should now see the BASIC copyright statement. You should now see the BASIC copyright statement and the BASIC prompt O.K. We suggest that you run the MGB-DEMO.BAS to verify the HBASIC if it's operate properly.

When using HBASIC, observe the following features:

1) HBASIC will not accept the following statements: COLOR; SCREEN 0; SCREEN1; WIDTH 40

2) HBASIC use a character size of 9 dots wide by 14 dots tall. BASICA uses a character size of 8 x 8 dots. Be aware of this difference when converting screen positions from rows and columns to x,y coordinates.

3) When you embed color specifications in a BASIC statement, they will be interpretted modulo 2. This means that if your color specification is 2 in a CIRCLE statement, then the circle will be drawn black.

4) The range of values of the screen coordinated are 0-709 horizontal from left to right, and 0-347 vertical from top to bottom.

5) The monochrome display has an aspect ratio of 2/3. Embed, this is a CIRCLE statement to get a round circle. Also, to draw a square, make the vertical lines 2/3s as long as the horizontal lines.

6) HBASIC interprets slower than BASICA, so timing loops will take longer to run.

7) To edit BASIC programs written for the IBM color card:
   a) Change SCREEN 0 and SCREEN 1 statements to SCREEN 2
   b) Eliminate the COLOR statements
   c) Change all WIDTH 40 statements to WIDTH 80
   d) Change the aspect ratios to 2/3s
   e) Change the x/y coordinated to compensate for the larger monochrome screen

8) When using HBASIC , you cannot display the second page of information. This is because BASICA does not allow you to. If you insist on seeing the second page by using the OUT command, you can damage the monitor.
   DON'T USE THE "OUT" COMMAND TO THE DISPLAY MODE CONTROL PORT.

B) HOW TO USE IBM'S DIAGNOSTICS DISKETTE

If you try to run the IBM diagnostic diskette with "MONOCHROME GRAPHICS BOARD," in your system, your screen will display jumbled patterns and you may damage your monitor. Follow these instructions carefully to make a working copy of the diagnostic program.

1) Make a copy of this diagnostics program, by formating a blank diskette and using the DISKCOPY or COPY command described in the DOS manual.

2) Boot DOS and wait for A>. Put your diagnostic copy in Drive B.

3) Type DEBUG B: DIAGS.COM ENTER.

4) After a minus sign and the cursor appear, type S 100 FFFF BA B8 03 B0 FF ENTER
The system will answer with MMMM:NNNN. (MMMM and NNNN represent hax numbers that will vary among versions of diagnostic disks)

5) Type E NNNN ENTER

6) Hit the space bar after each of the following: BA.; B8.; 03.; and B0. After FF., type 7D ENTER

7) After the minus sign and the cursor, type W ENTER

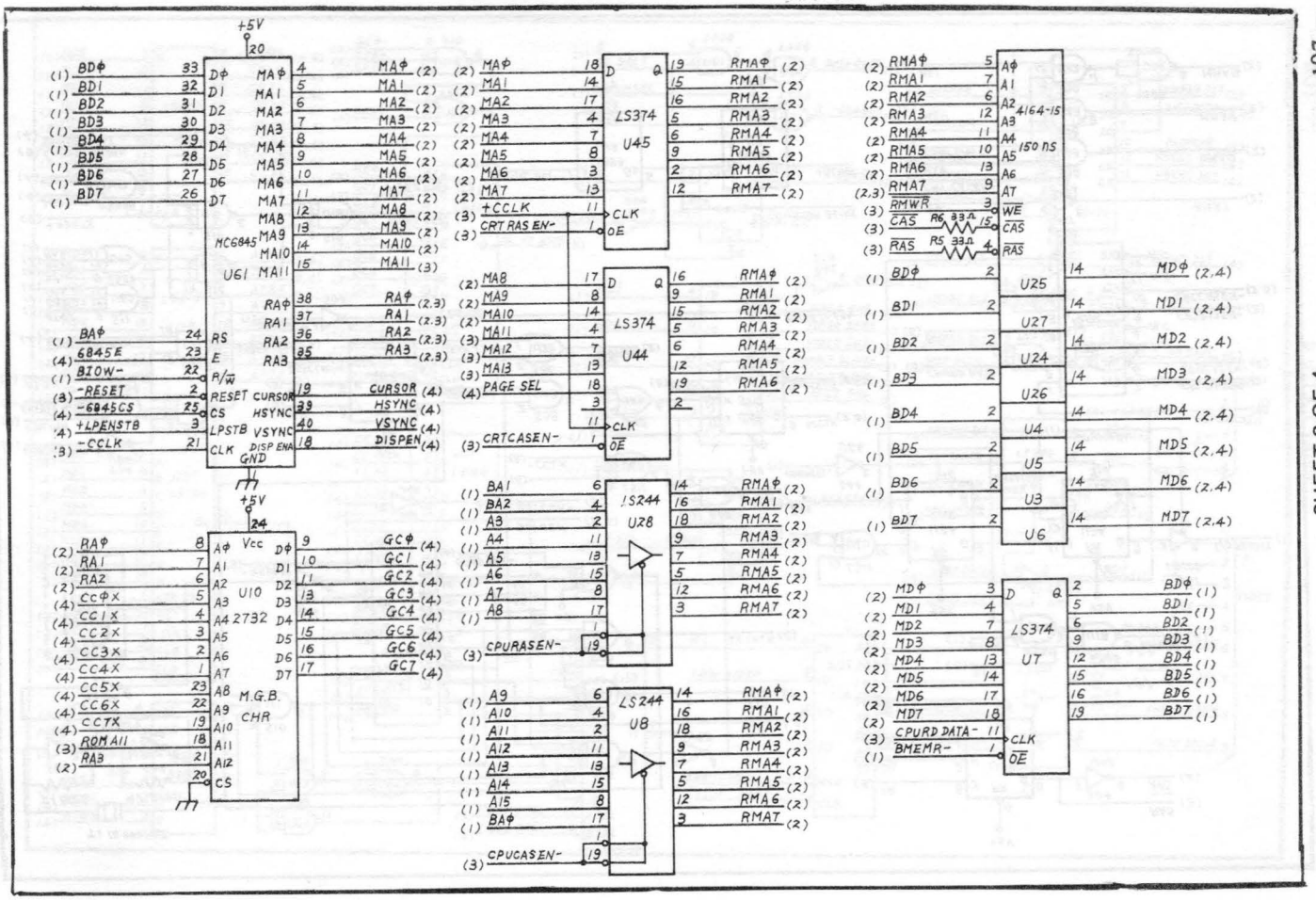
8) After the minus sign and cursor, type Q ENTER The A> should reappear.

9) To run the diagnostic program, put your diagnostic copy in Drive A. Hold down the Alt, Ctrl and Del keys simulatneously to reset the system and start the diagnostics program.

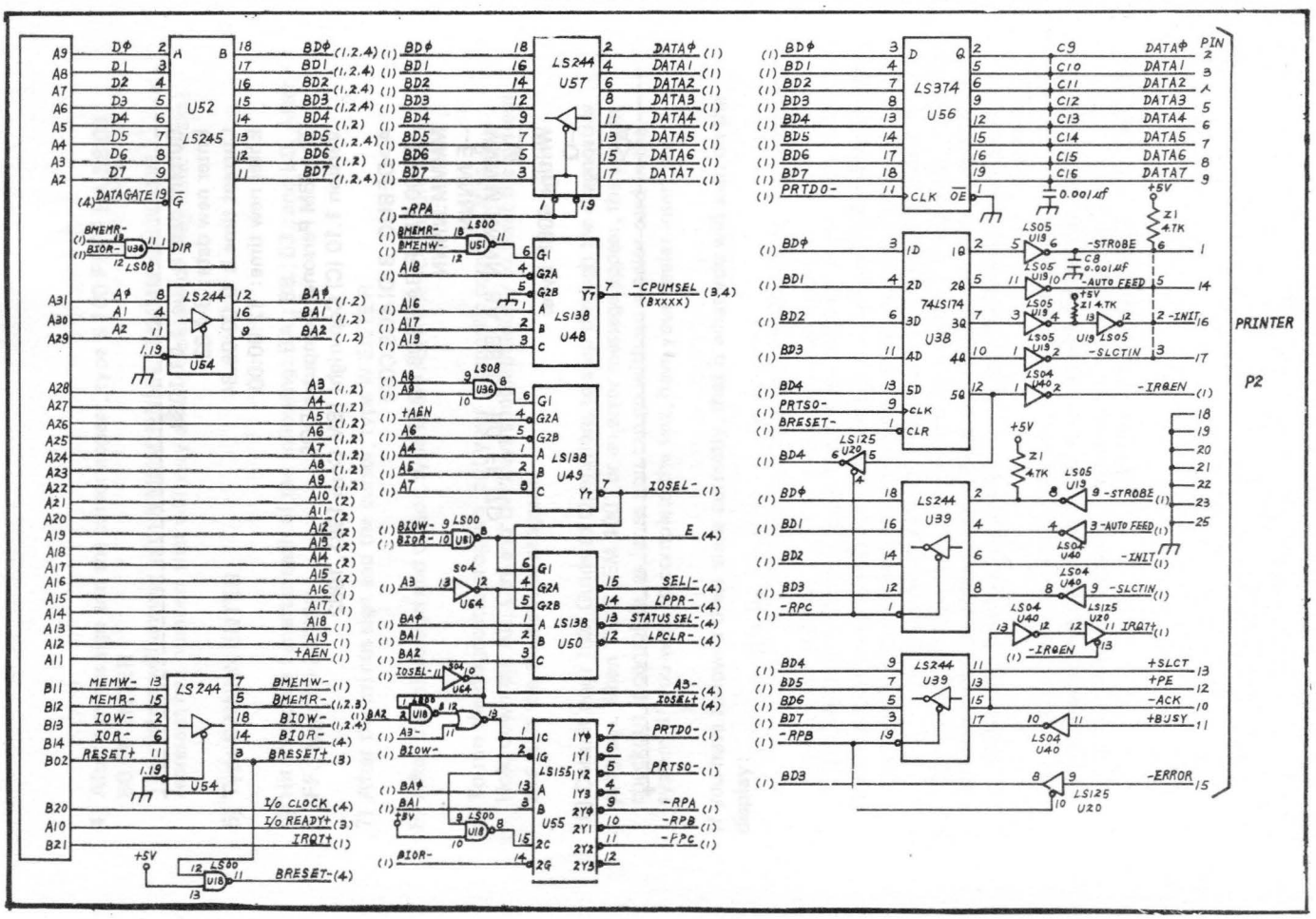
10) Consult your IBM Guide to Operations to step through the diagnostics program. When "SYSTEM 400" or an error message appear, the system checkout is complete, as far as you can go without a color card in the system. If you wish to complete the test, have your dealer insert one.

If you have followed these steps correctly, that is what you will seen on the display:

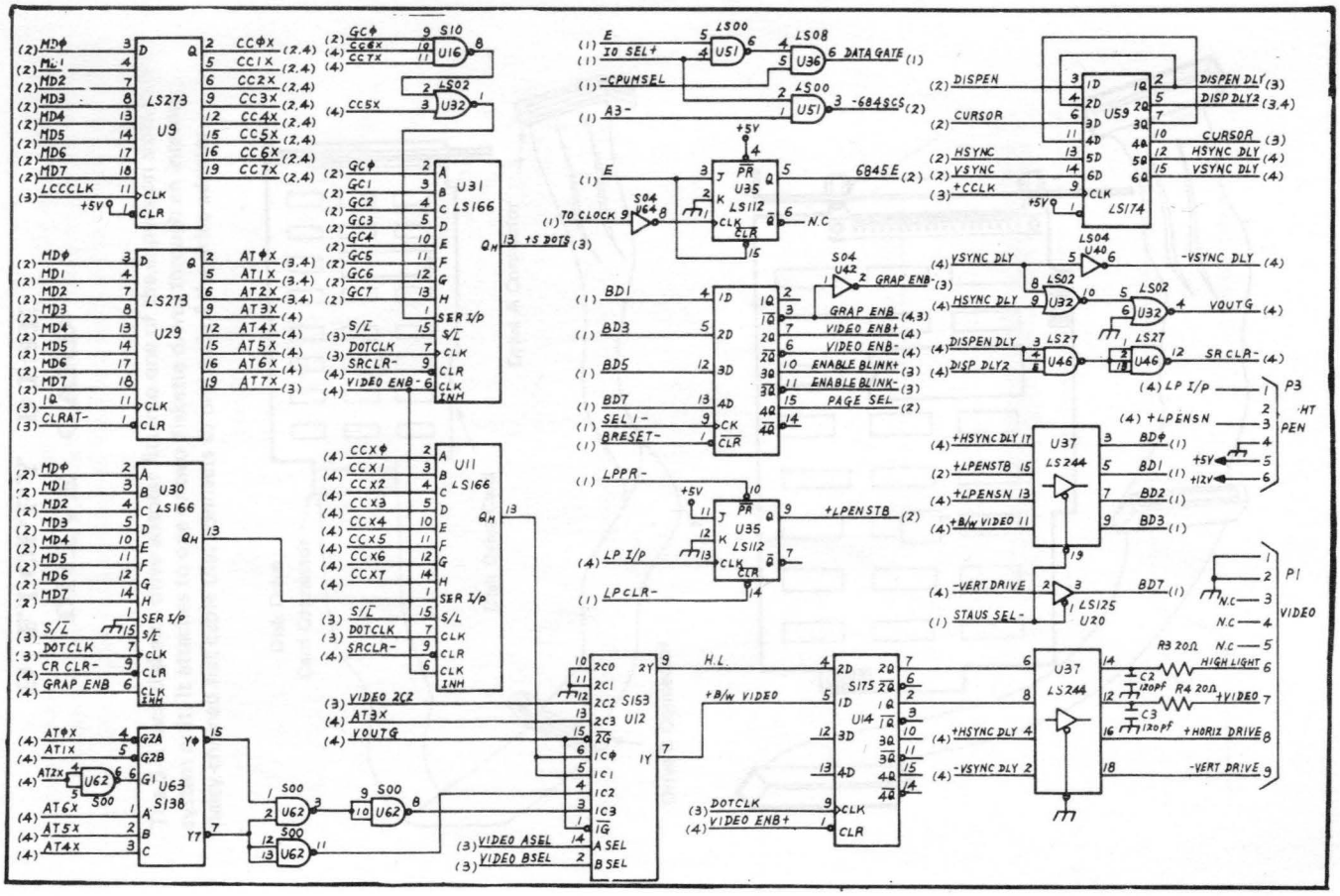

```
Current date is Tue  1-01-1980
Enter new data: 3-4-83
Current time is  0:00:08.84
Enter new time:  12:00:00

The IBM Personal Computer DOS
Version 1.10 (C) Copyright IBM Corp 1981, 1982

A>DEBUG  B:DIAGS.COM
-S 100 FFFF BA B8 03 B0 FF
MMMM:NNNN
-E NNNN
MMMM:NNNN  BA. B8. 03. B0. FF. 7D.
-W
Writing 40BF bytes
-Q

A>
```

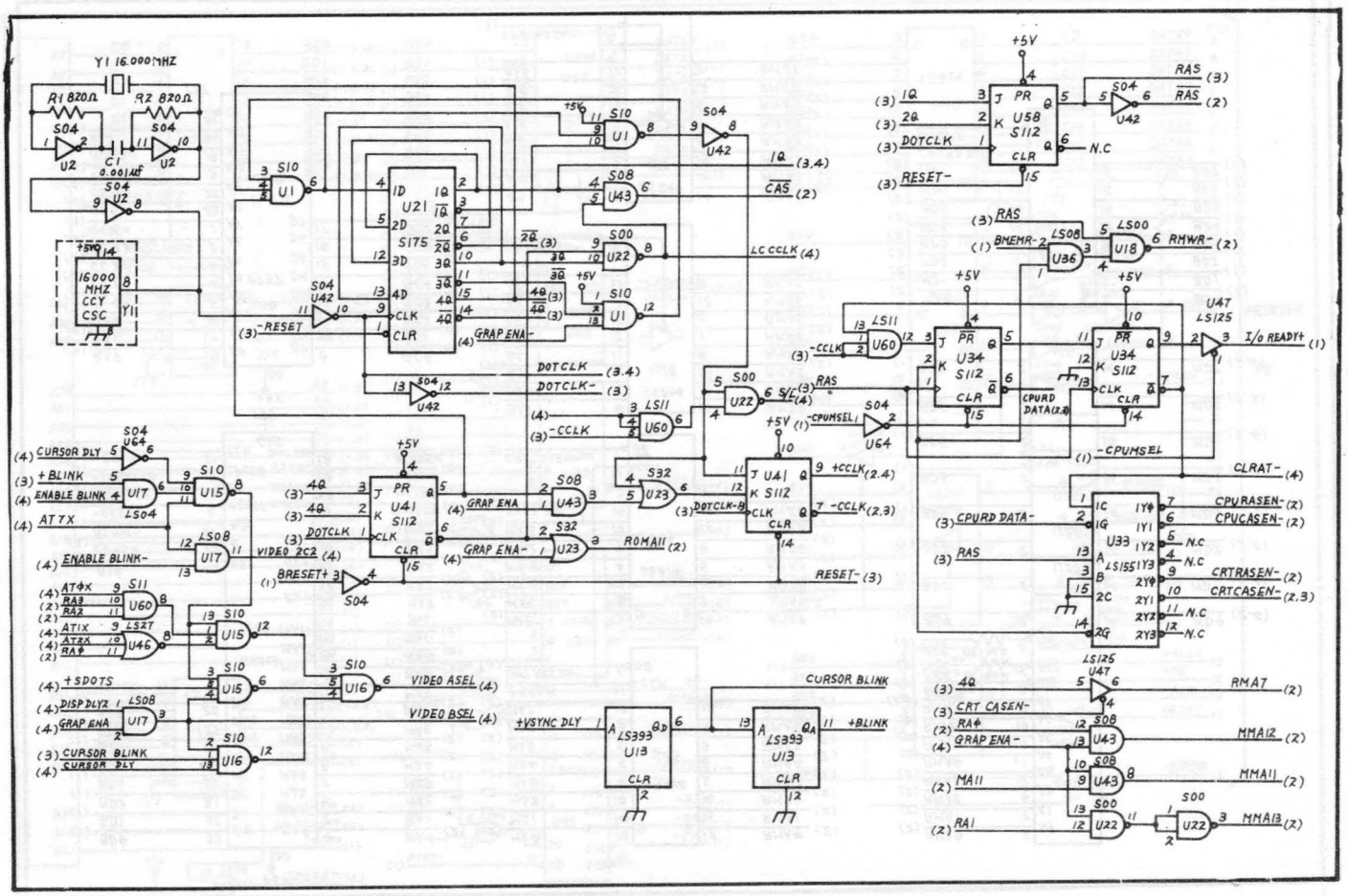


SHEET 2 OF 4



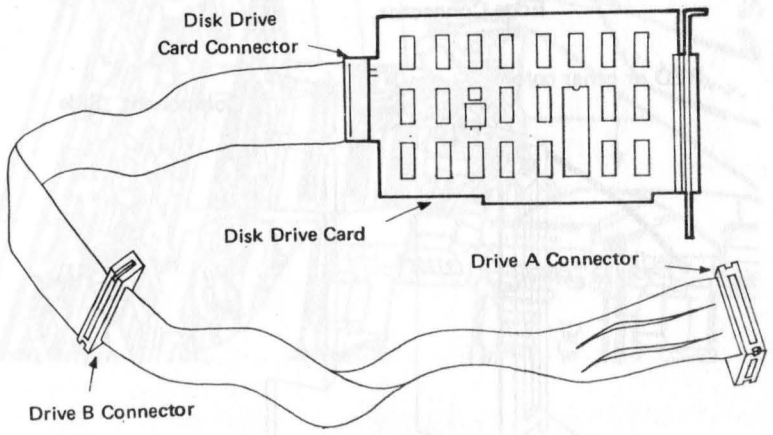
SHEET 1 OF 4

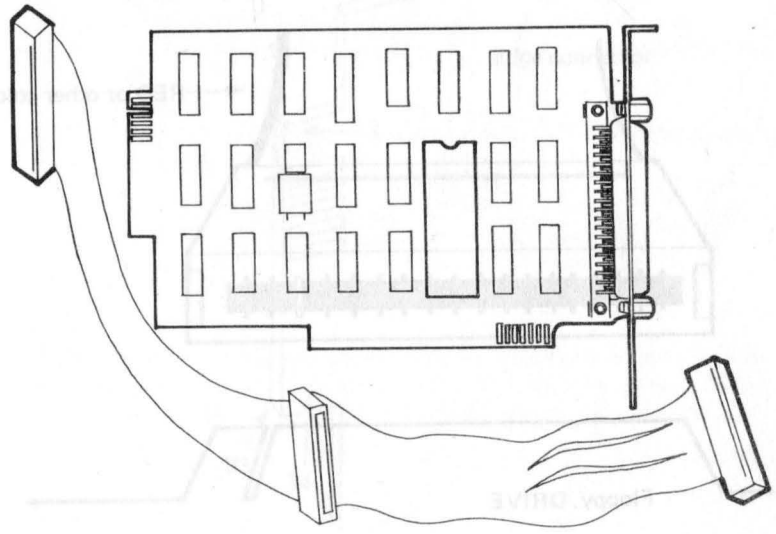




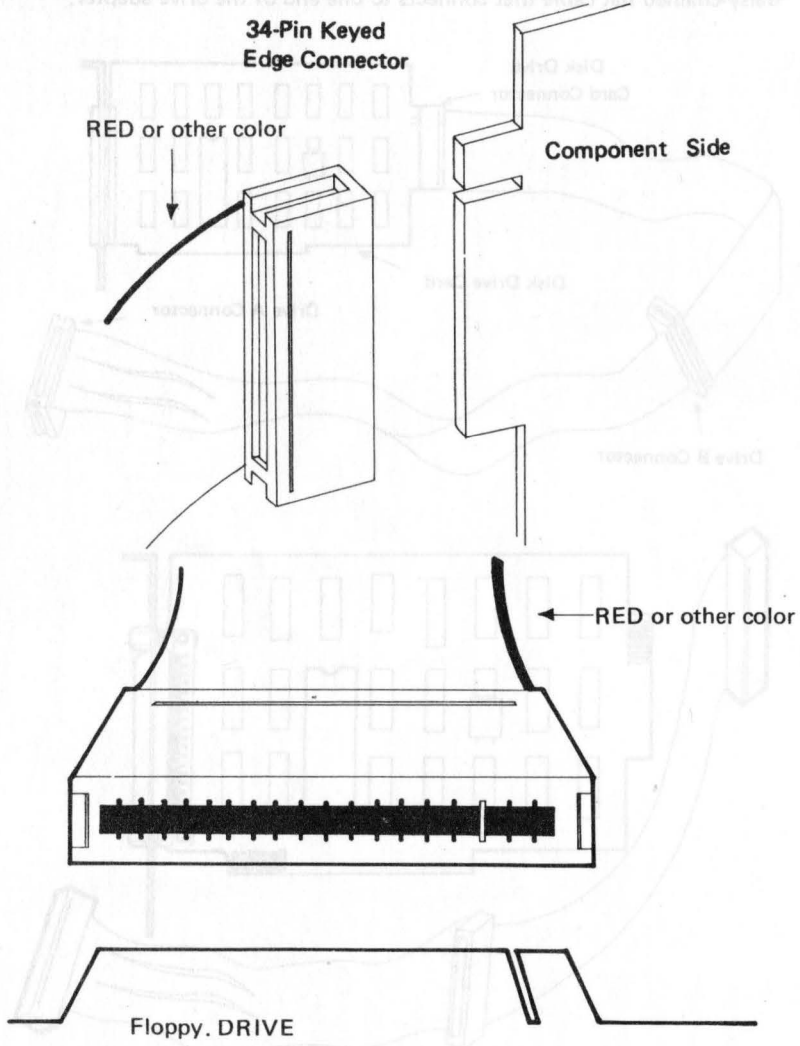
9 FLOPPY DISK DRIVE CARD

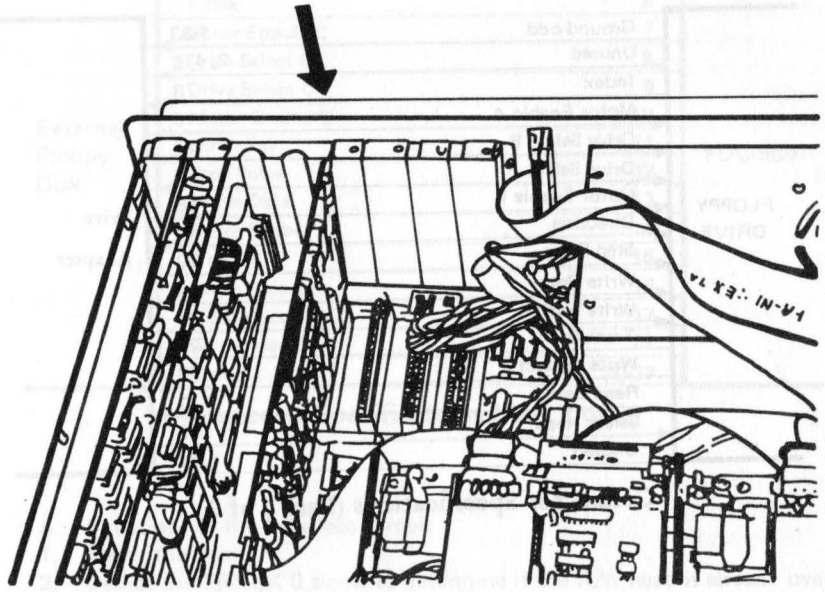
The 5-¼ inch diskette drive adapter fits into one of the expansion slots in the system unit. It attaches to one or two diskette drives through an internal, daisy-chained flat cable that connects to one end of the drive adapter.

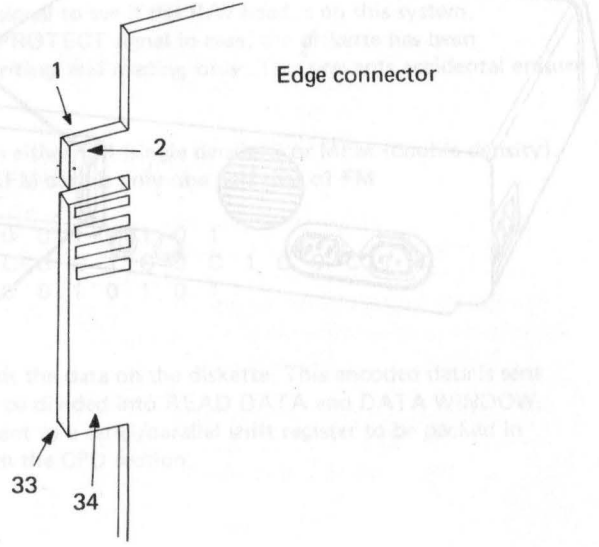


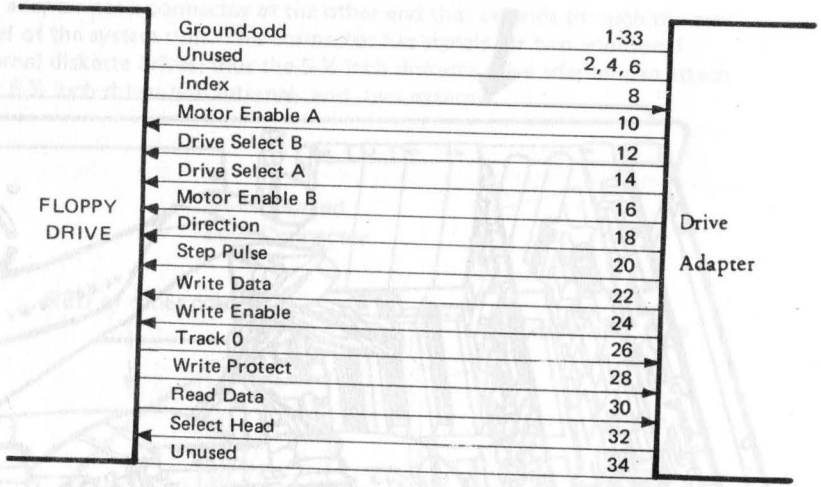


The adapter has a connector at the other end that extends through the rear panel of the system unit. This connector has signals for two additional external diskette drives; thus the 5-¼ inch diskette drive adapter can attach four 5-¼ inch drives two internal and two external.

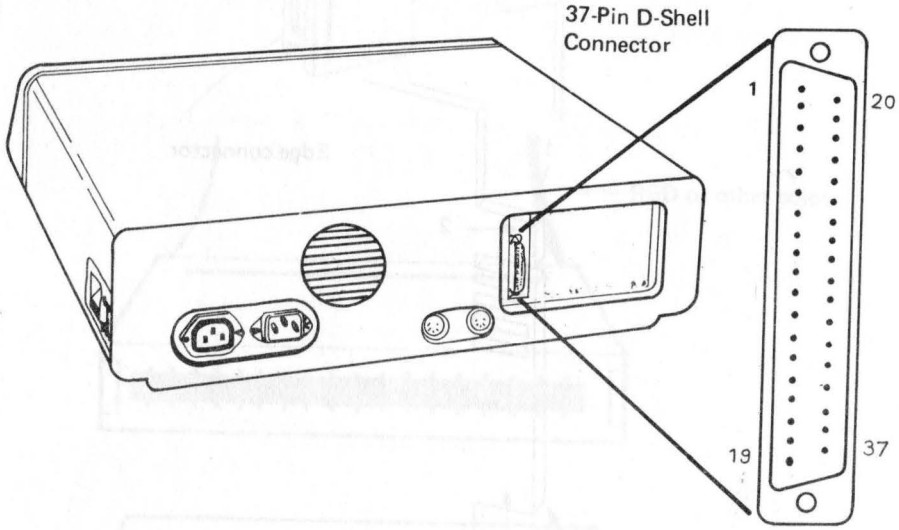


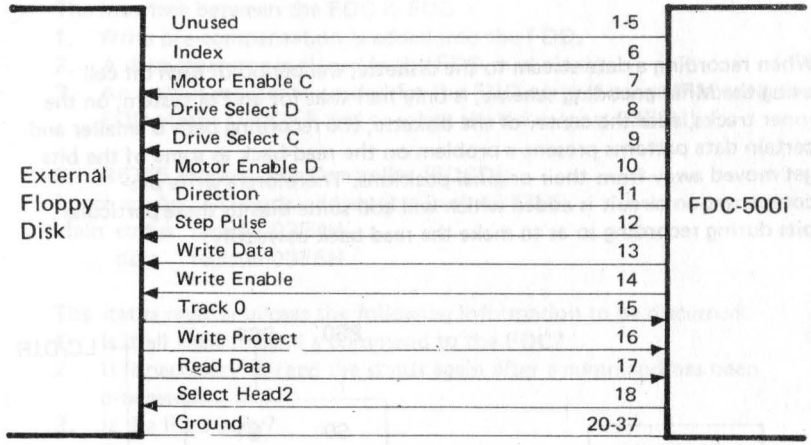






Connector Specifications (Part 1 of 2)





Connector Specifications (Part 2 of 2)

A. Functions of the Interface Circuit

1. Select the drive.
2. Detect the TRACK 0 singal to determine if the R/W head is already over track 0.
3. Detect the READY signal to see if the disk drive has a diskette properly inserted and the door closed.
4. Detect the INDEX signal to see if the R/W head is on this system.
5. Detect the WRITE PROTECT signal in case, the diskette has been protected against writing and reading only. This prevents accidental erasure of Valuable data.

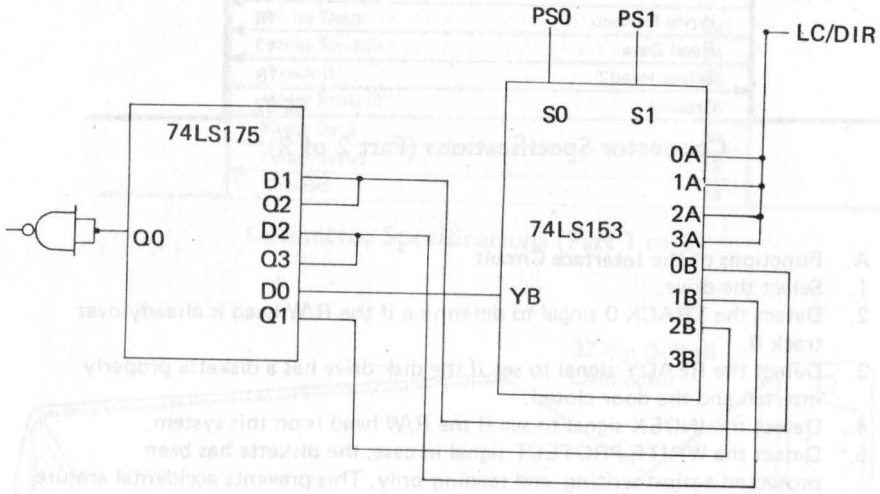
Data may be recorded in either FM (single density.) or MFM (double density). format. The period of MFM data is only one half that of FM

Data stream	0	0	0	1	0	1	0	1						
FM encoding	0	C	0	C	1	C	0	C	1	C	0	C	1	C
MFM encoding	0	0	0	1	0	1	0	1						

B. Data Separator

The FDD R/W head reads the data on the diskette. This encoded data is sent to the data separator to be divided into READ DATA and DATA WINDOW. It is then decoded and sent to a serial/parallel shift register to be packed in to 8 bit bytes and sent to the CPU section.

When recording a data stream to the diskette, the period of each bit cell using the MFM encoding scheme, is only half that for an FM system, on the inner tracks, near the center of the diskette, the recording path is smaller and certain data patterns present a problem on the read-back as some of the bits get moved away from their original positions. Therefore a write pre-compensation circuit is added which will add some bias to these particular bits during recording so as to make the read back correctlly.



	PRESTSHIFT 0	PRESTSHIFT 0
NORMAL	0	0
LATE	0	1
EARLY	1	0
INVALID	1	1

The interface between the FDC & FDD

1. Write pre-compensation is added into the FDD.
2. A data separator is placed in the FDD read circuit.
3. An output register is needed for the FDD control program to switch the FDD motor ON/OFF and to select the drive (port 03F2H)

C. R6765 Floppy Disk Controller (FDCD)

There are two I/O ports addressable in the R6765:

Main status register-03F4H
data register-03F5H

The status register allows the following information to be discerned:

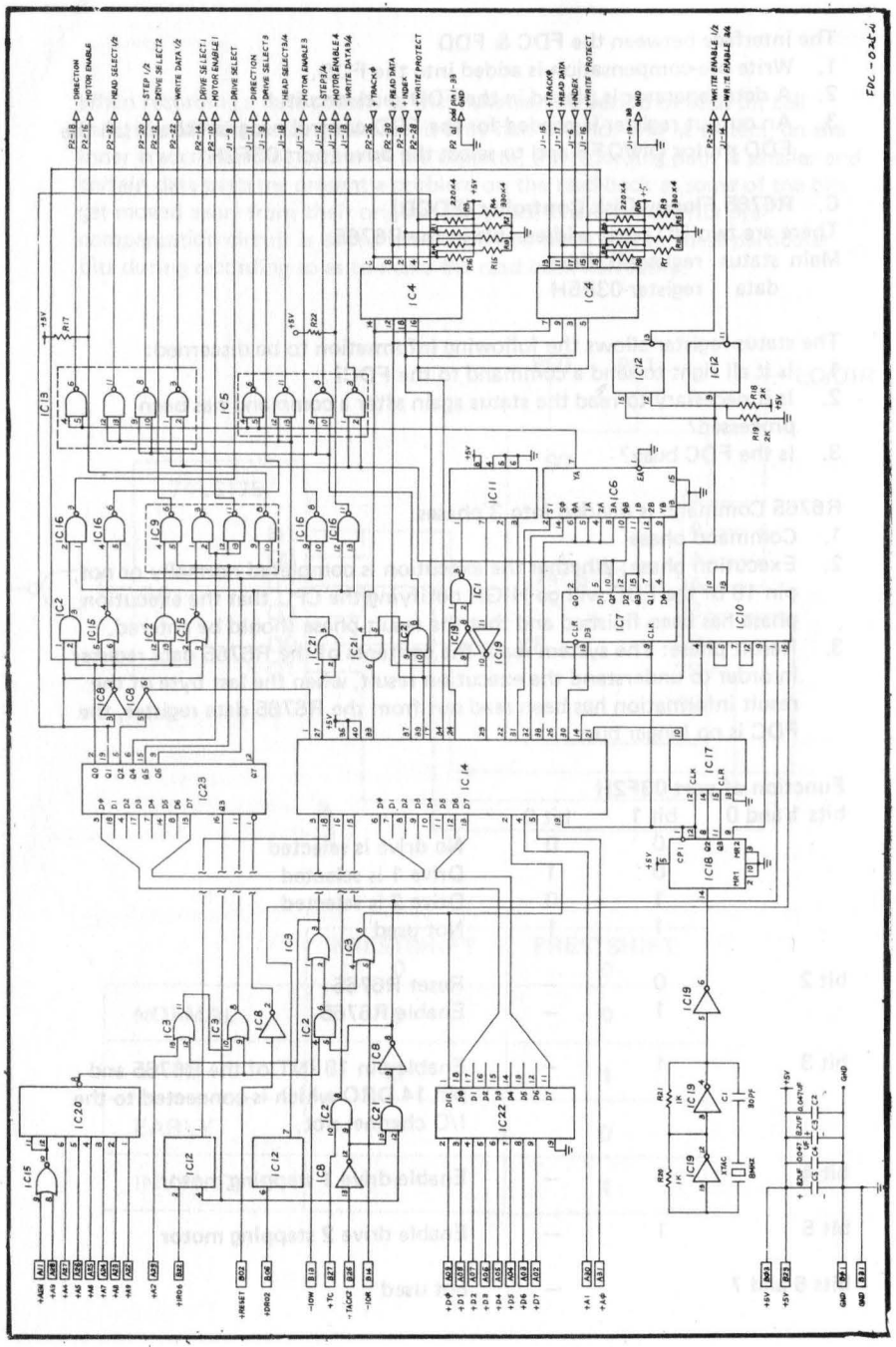
1. Is it all right to send a command to the FDC?
2. Is it necessary to read the status again after a command has been processed?
3. Is the FDC busy?

R6765 Command is divided into 3 phases:

1. Command phase
2. Execution phase: Whether the execution is completed normally or not, pin 18 of the FDC will go HIGH notifying the CPU that the execution phase has been finished and that the result phase should be entered.
3. Result phase: The system reads the contents of the R6765 data register in order to understand the execution result, when the last byte of the result information has been read out from the R6765 data register, the FDC is no longer busy.

Function of port 03F2H

	bit 1	bit 0	
bits 1 and 0	0	0	No drive is selected
	0	1	Drive 1 is selected
	1	0	Drive 2 is selected
	1	1	Not used
bit 2	0	–	Reset R6765
	1	–	Enable R6765
bit 3	1	–	Enable pin 18 INT of the R6765 and pin 14 DRQ which is connected to the I/O channel slot.
bit 4	1	–	Enable drive 1 stepping motor.
bit 5	1	–	Enable drive 2 stepping motor
bits 6 and 7		–	not used



10 POWER SUPPLY

The system power supply is located at the right rear of the system unit. It is designed to be an integral part of the system-unit chassis. Its housing provides support for the rear panel, and its fan furnishes cooling for the whole system.

It supplies the power and reset signal necessary for the operation of the system board, installable options, and the keyboard. It also provides a switched AC socket for the monochrome display and 2⁄3 separate connectors for power to the 5¼ inch diskette drives or 10M Fixed Drive.

65W Power Supply

It is a dc-switching power supply designed for continuous operation at 63.5 watts. It has a fused 120–Vac input and provides four regulated dc output voltages: 7A of +5 Vdc, 2A of +12 Vdc, 0.3A of –5 Vdc, and 0.25A of –12 Vdc. These outputs are over-voltage, over-current, open-circuit, and short-circuit protected. If a dc overload or over-voltage condition occurs, all dc outputs are shut down as long as the condition exists.

The +5 Vdc powers the logic on the system board and the diskette drives and allows approximately 4A of +5 Vdc for the adapters in the system-unit expansion slots. The +12 Vdc power level is designed to power the system's dynamic memory and the two internal 5¼ inch diskette drive motors. It is assumed that only one drive is active at a time. The –5 Vdc level is designed for dynamic memory bias voltage; it tracks the +5 Vdc and +12 Vdc very quickly at power-on and has a longer decay on power-off than the +5 Vdc and +12 Vdc outputs. The +12 Vdc and –12 Vdc are used for powering the EIA drivers on the communications adapters. All four power levels are bussed across the five/seven/eight system-unit expansion slots.

65 POWER SUPPLY

Input Requirements

The following are the input requirements for the system unit power supply.

Voltage (vac)			Frequency (Hz)	Current (Amps)
Nominial	Minimum	Maximum	+/– 3Hz	Maximum
120	104	127	60	2.5 at 104 Vac

Vdc Output

The following are the DC outputs for the system unit power supply.

Voltage (Vdc)	Current (Amps)		Regulation (Tolerance)	
Nominal	Minimum	Maximum	+ %	– %
+ 5.0	2.3	7.0	5	4
– 5.0	0.0	0.3	10	8
+12.0	0.4	2.0	5	4
–12.0	0.0	0.25	10	9

100W POWER SUPPLY

The 100-WATT, 4 voltage level switching regulator. It is integrated into the expansion unit and supplies power for the computer system, and its options. The supply provides 10A of +5 Vdc, plus or minus 5%, 3A of +12 Vdc, plus or minus 5%, 300mA of –5 Vdc, plus or minus 10%, and 250mA of –12 Vdc, plus or minus 10%.

All power levels are requlated with Over-Voltage and Over-Current protection. The input is 120 Vac and fused. If DC Over-Load or Over-Voltage condition exists, the supply automatically shuts down, until the condition is corrected. The supply is designed for continuous operation at 100 watts.

Voltage (Vac)			Frequency (Hz)	Current (Amps)
Nomimal	Minimum	Maximum	+/– 3Hz	Maximum
120	104	127	50/60	3.2 at 100 Vac

Voltage (Vdc)	Current (Amps)		Regulation (Tolerance)	
Norminal	Minimum	Maximum	+ %	– %
+ 5.0	2.3	10.0	5	4
– 5.0	0.0	0.3	10	8
+12.0	0.4	3.0	5	4
–12.0	0.0	0.25	10	9

135W POWER SUPPLY

The expansion unit DC power supply is a 130-watt, 4 voltage level switching regulator. It is integrated into the expansion unit and supplies power for the expansion unit, and its options. The power supply provides 15A of +5 Vdc, plus or minus 5%, 4.2A of +12 Vdc, plus or minus 5%, 300mA of −5 Vdc, plus or minus 10%, and 250mA of −12 Vdc, plus or minus 10%. All power levels are regulated with over-voltage and over-current protection. The input is 120 Vac and fused. If DC over-load or over-voltage condition exist, the supply automatically shuts down until the condition is corrected. The supply is designed for continuous operation at 135 watts.

The power supply was located at the right rear of the expansion unit. It supplies operating voltages to the expansion board, and provides two separate connections for power to the fixed disk drives.

Voltage (Vac at 50/60 Hz)			Frequency (Hz)	Current (Amps)
Nominal	Minimum	Maximum	+/− 3Hz	Maximum
120	104	127	50/60	4.1 at 90 Vac

Voltage (Vdc)	Current (Amps)		Regulation (Tolerance)	
Nominal	Minimum	Maximum	+ %	− %
+ 5.0	2.3	15.0	5	4
− 5.0	0.0	0.3	10	8
+12.0	0.4	4.2	5	4
−12.0	0.0	0.25	10	9

Over-Voltage/Over-Current Protection

The system power supply exploys protection features which are described below.

Primary (input)

The following table describes the primary (input voltage) protection for the system-unit power supply

W	Voltage (Nominal Vac)	Type Protection	Rating (Amps)
65W	120	Fuse	2
100W	120	Fuse	3.5
135W	120	Fuse	5

Secondary (Output)

On over-voltage, the power supply is designed to shut down all outputs, when either the +5 Vdc or the +12 Vdc output exceeds 200% of its maximum rated voltage. On over-current, the supply will turn off if any output exceeds 130% of its nominal value.

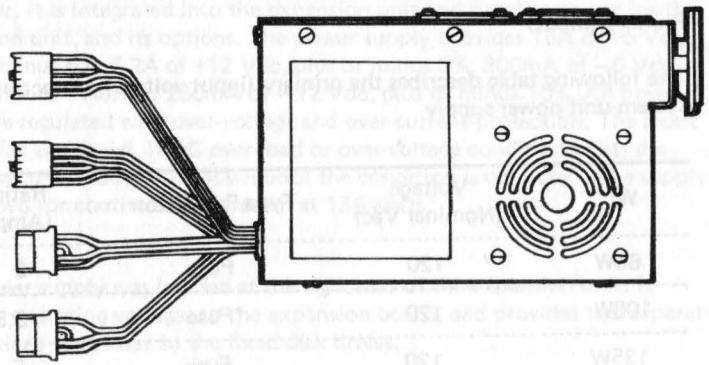
Power-Good Signal

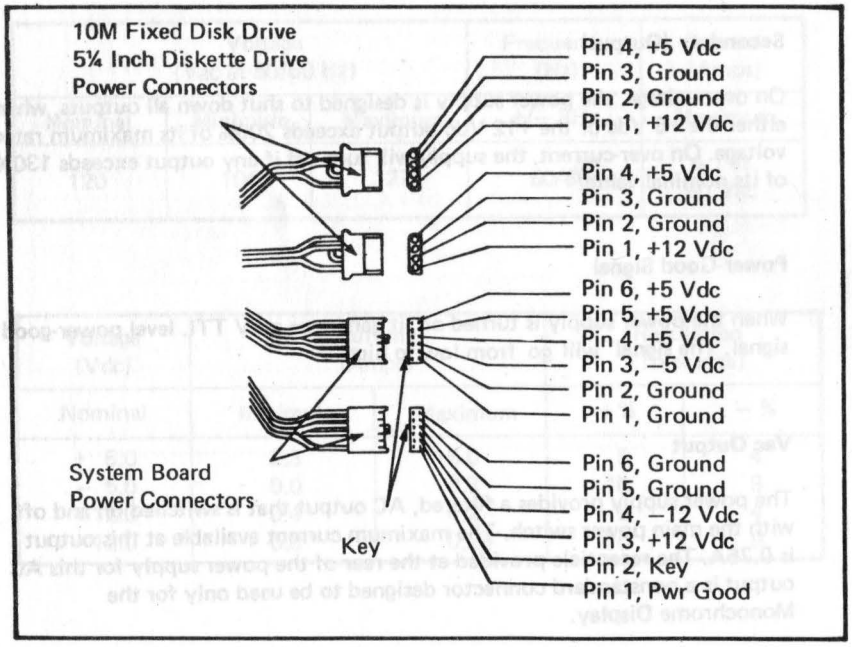
When the power supply is turned on, it generates a 5V TTL level power-good signal. The signal will go from low to high.

Vac Output

The power supply provides a filtered, AC output that is switched on and off with the main power switch. The maximum current available at this output is 0.75A. The recepticle provided at the rear of the power supply for this AC output is a nonstandard connector designed to be used only for the Monochrome Display.

65/100/135W POWER SUPPLY





INDICATION

SOURCETEK SWITCHING POWER SUPPLY

CAUTION! HAZARDOUS AREA

Under no circumstance should this machine be opened. It is advisable not to use any serviceable parts on this machine and danger high voltage inside this case. In event of difficulty, please notify your dealer for prompt service.

ATTENTION! ZONE DANGEREUSE
VORSICHT! GEFAHRENZONE
ATTENZIONE! PERICOLO
PRECAUCION! AREA PELIGROSA
注意！ 高压危險
إحترس : مساحة خطار

POWER DISSIPATION INDICATION

- 65W
- 100W
- 130W

VOLTAGE INDICATION

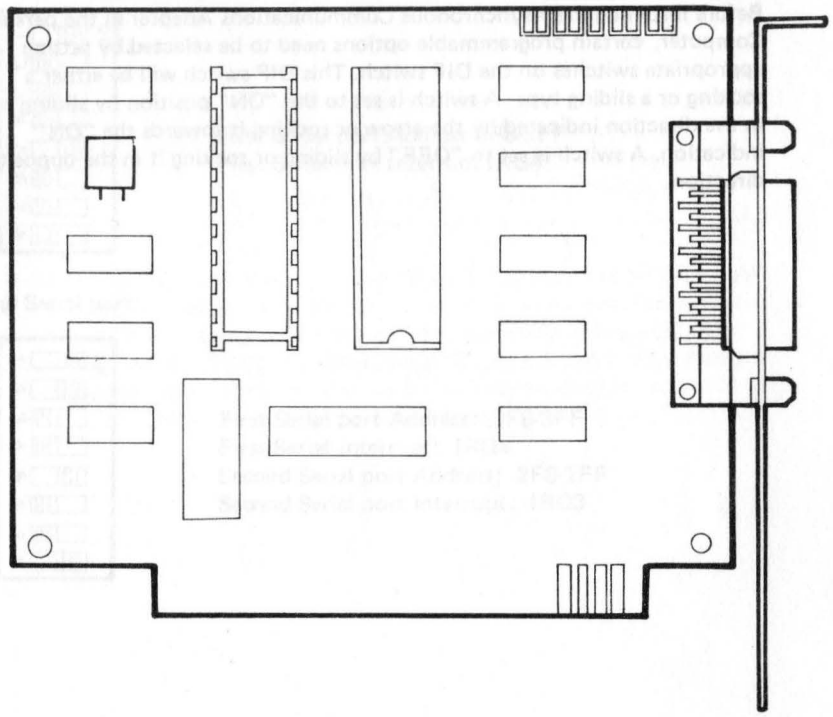
- 110V
- 220V

APPENDIX:

ASYNCHRONOUS COMMUNICATIONS ADAPTER

The PC/XT Asynchronous Communications Adapter is an expandable standard EIA RS-232C interface that is fully programmable and supports IBM asynchronous communications. The adapter can be expanded to a second serial port. A programmable baud rate generator allows operation from 50 baud to 9600 baud. Five, six, seven or eight bit characters with 1, 1½, or 2 stop bits are supported. A fully prioritized interrupt system controls transmit, receive, error, line status and dtat set interrupts. However, there is one small difference and that is the 20 milliamp current loop interface option is not implemented on the Asynchronous Communications Adapter.

BASICA and DOS 1.1 provide simple commands to set the serial port's programmable features. Additionally. a programmer can program the serial interfaces to meet any special needs. Diagnostic capabilities provide loopback functions of transmiting/receiving output/input signals.

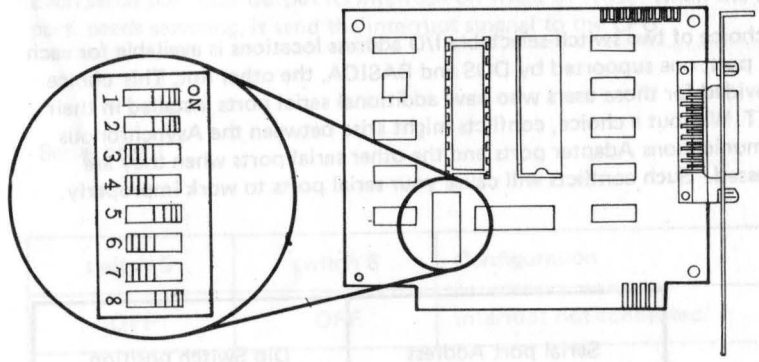


The first serial interface is implemented as Data Terminal Equipment (DTE) and used a male 25 pin D-type connector mounted on the board. Additional sockets provided on the board allow for the installation of a second optional serial port which is also implemented as DTE. An expansion kit is necessary for this operation.

The connector for the first serial port is mounted at the rear of the board and has an IBM expansion slot panel mounted to it that replaces the installed blank panel. The connection for the optional second serial port is made at a 10 pin single row connector located adjacent to the first connector. One 10 pin-to-25 pin female D-type connector adapter cable is need to provide a standard RS-232 connection point.

Each serial port's address location and interrupt line is independently switch selectable. If there are other serial ports installed in the pc, provisions are made on the Asynchronous Communications adaptor for selecting alternate I/O address locations and interrupts.
The Asynchronous Communications Adapter may be plugged into any slot in the personal Computer. Refer to the operation manual for more detailed instructions for opening the PC/XT chassis and installing option boards.

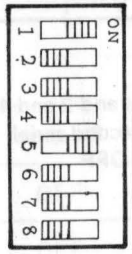
Before installing the Asynchronous Communications Adapter in the personal Computer, certain programmable options need to be selected, by setting appropriate switches on the DIP switch. This DIP switch will be either a rocking or a sliding type. A switch is set to the "ON" position by sliding it in the direction indicated by the arrow or rocking it towards the "ON" indication. A switch is set to "OFF" by sliding or rocking it in the opposite direction.



When the Asynchronous Communications Adapter is shipped from the factory, the switches are set as follows:

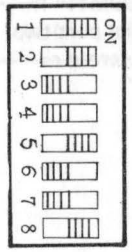
Factory setting:

Single Serial port



First Serial port Address 3F8-3FF
First Serial port Interrupt IRQ4

Dual Serial port



First Serial port Address: 3F8-3FF
First Serial Interrupt: IRQ4
Second Serial port Address: 2F8-2FF
Second Serial port Interrupt: IRQ3

The choice of two switch-selectable I/O address locations is available for each serial port, one supported by DOS and BASICA, the other not. This choice is provided for those users who have additional serial ports installed in their PC/XT. Without a choice, conflicts might arise between the Asynchronous Communications Adapter ports and the other serial ports when they are addressed. Such conflicts will cause your serial ports to work improperly.

	Serial port Address	Dip Switch position
Port 1	3F8-3FF (Supported by DOS, BASICA)	1-on/3-off
	3E8-3FF (not supported)	1-off/3-on
Port 2	2F8-2FF (Supported by DOS, BASICA)	2-on/4-off
	2E8-2EF (not supported)	2-off/4-on

NOTE: Switches 1 and 3 should never be ON at the same time: and 2 and 4 should never be ON at the Same time. If the optional second serial port is not installed, Switches 2 and 4 should be in the OFF position.

Depending on the settings for switches 1 and 2. Dos and BASICA will refer to each serial port either as "COM 1:" or "COM 2:" If switch 1 is ON and 2 is OFF, DOS and BASICA will refer to the first serial port as "COM1:" If switch 1 is OFF and 2 is ON, DOS and BASICA will refer to serial port two as "COM 1:" If both switch 1 and 2 are ON, serial port one is referred as "COM 1:" and the second serial port is referred to as "COM 2:"

Each serial port may output its interrupt on IRQ4 or IRQ3. When the serial port needs servicing, it send the interrupt singnal to the CPU.

Serial port 1

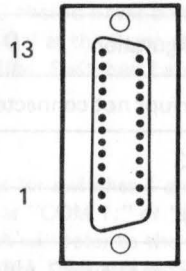
switch 5	switch 6	Configuration
OFF	OFF	interrupt not connected
OFF	ON	IRQ 3
ON	OFF	IRQ 4
ON	ON	Never configure 5 and 6 so they are both on

Serial port 2

switch 5	switch 6	configuration
OFF	OFF	Interrupt not connected
OFF	ON	IRQ3
ON	OFF	IRQ4
ON	ON	Never configure 7 and 8 so they are both on

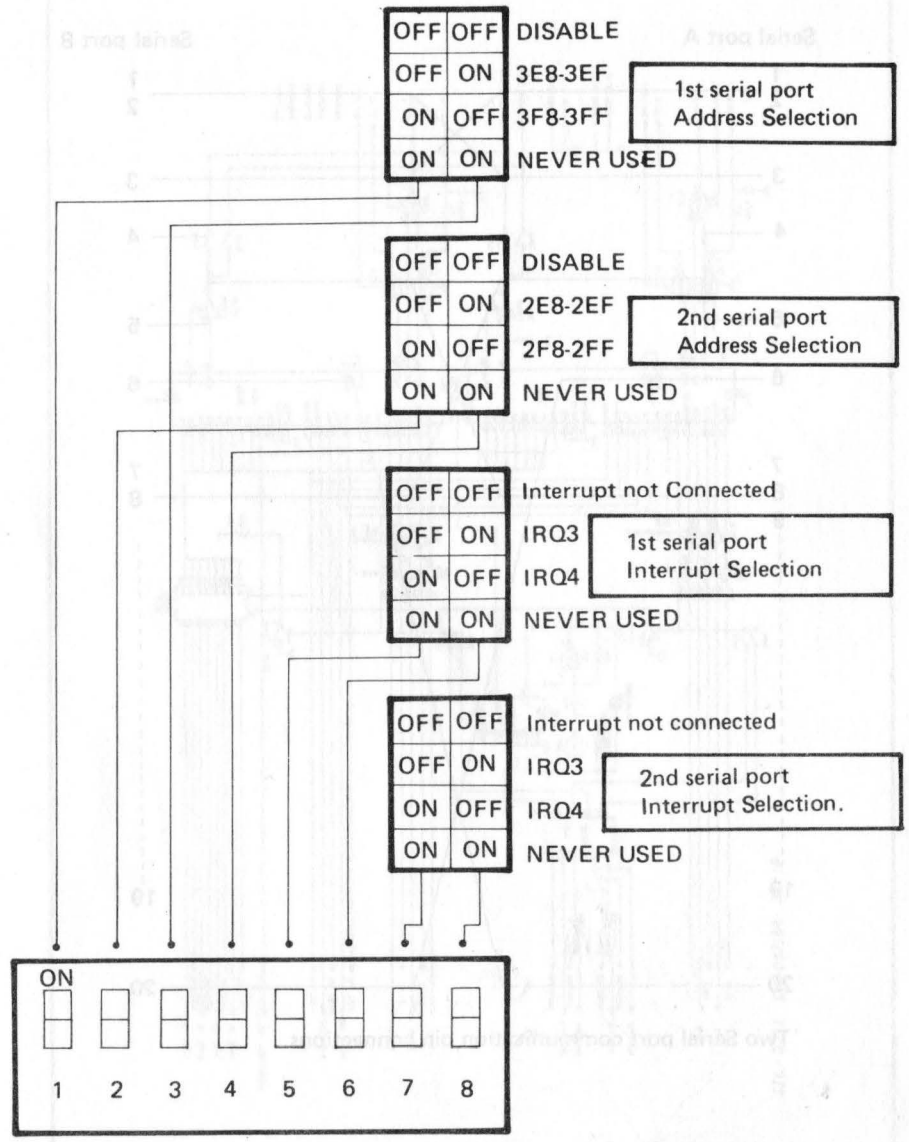
The following table losts the RS-232 singals that are used on the Asynchronous Communications Adapter Connectors.

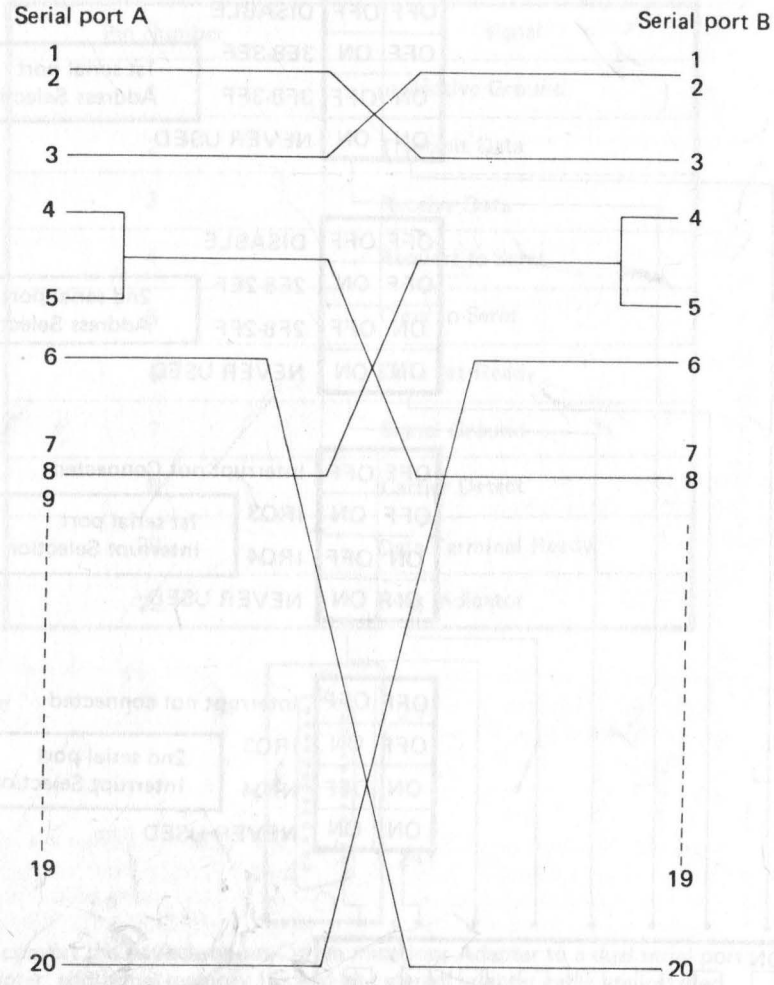
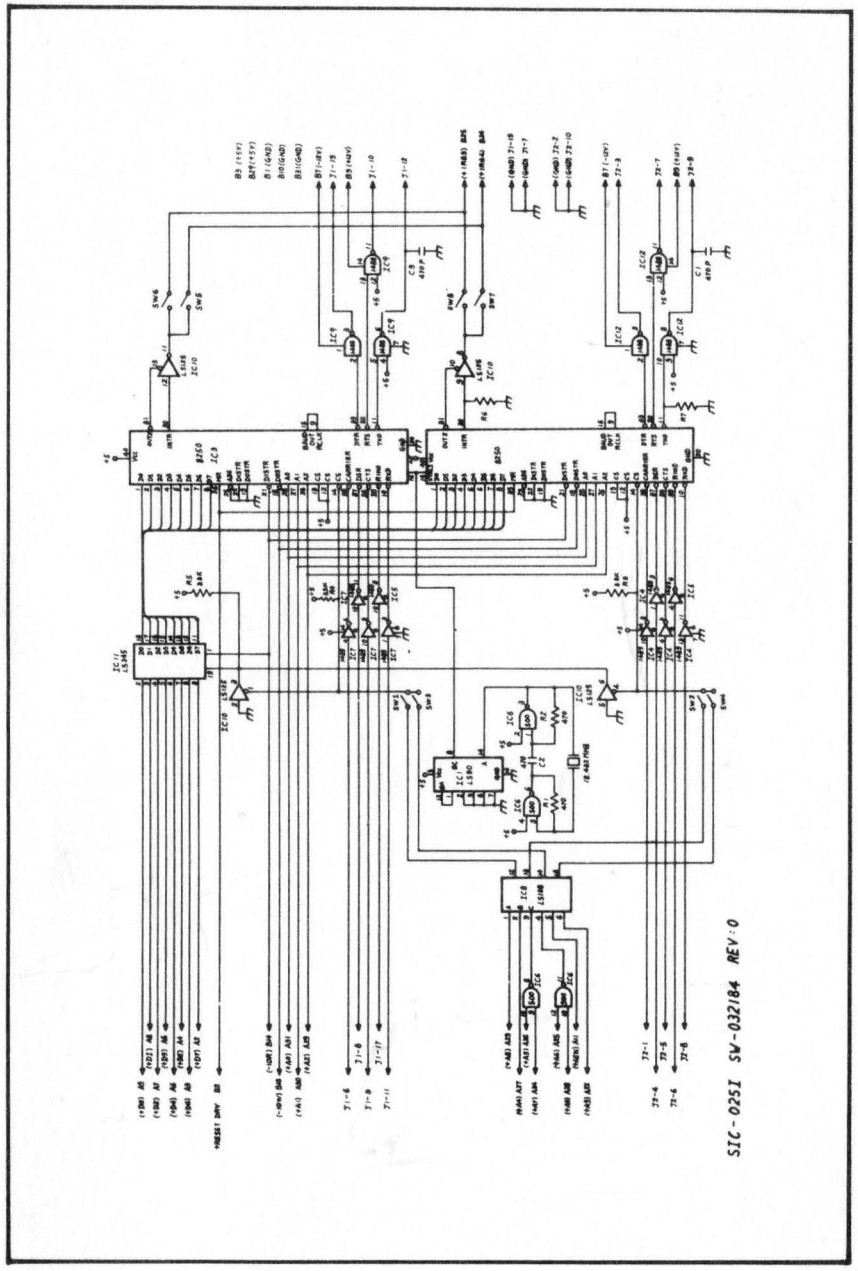
Pin Number	signal
1	protective Ground
2	Transmit Data
3	Receive Data
4	Request to Send
5	Clear to Send
6	Data Set Ready
7	Signal Ground
8	Carrier Detect
20	Data Terminal Ready
22	Ring Indicator



To convert the Asynchronous Communications Adapter to a dual serial port adapter, additional memory ICs and an external adapter cable are installed on the printed circuit board.

The additional ICs include a 40-pin DIP (INS 8250), which should be inserted into the memory board socket Marked IC4, and another 14-pin DIP (MC1488), which should be inserted into the socket Marked IC2, a 14-pin DIP (MC 1489) which should be inserted in the socket marked U9.





Two Serial port communication pin connections